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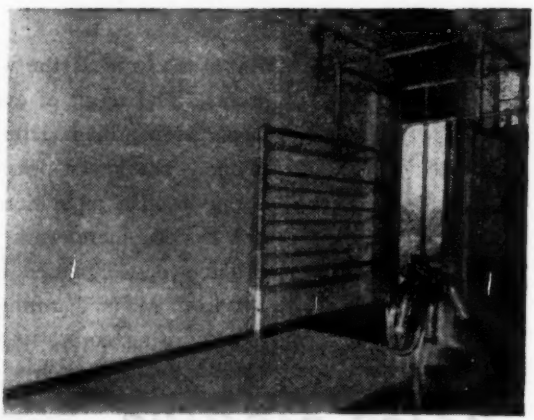

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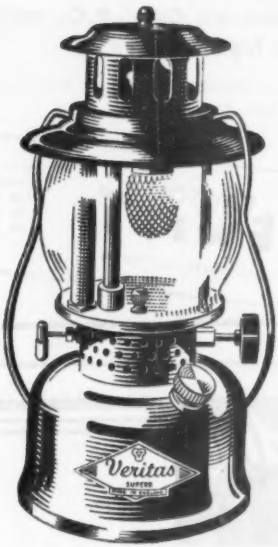

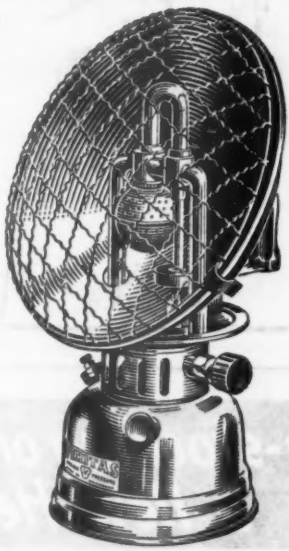

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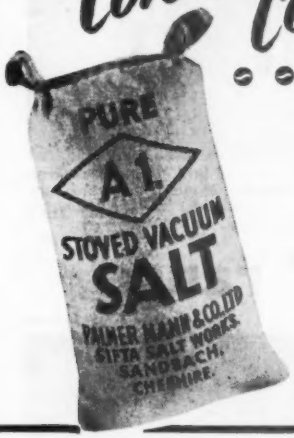

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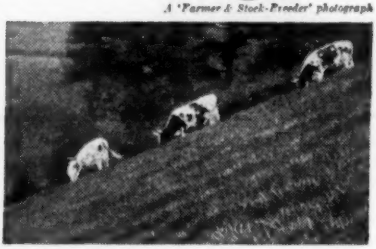

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AGRICULTURE

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VOL. LIX No. 10 JANUARY 1953

RESEARCH FOR PLENTY

No. 3. CONTROLLING PLANT DISEASES

F. C. BAWDEN, M.A., F.R.S.
Rothamsted Experimental Station, Harpenden, Herts

IN Western civilizations only a small minority of people are now engaged in growing food, an occupation the townsman often sentimentally describes as the natural life. Nothing could be further from the truth. Agriculture is an industry every bit as artificial as any other ; a crop of wheat or potatoes is just as much a product of man's activities, and is no more a natural phenomenon, than is a factory or a mine. To think otherwise is to misunderstand the revolutionary action of those who first turned from food gathering and hunting to agriculture ; and this misunderstanding obscures both the immense changes the world has undergone as a result of agriculture and the reasons for the many problems and difficulties that today confront the growers of crops.

It was only a few thousand years ago that Man started to produce his food by raising crops. The new culture was so successful, and developed so rapidly, that, within this trivial fraction of the world's total history, most of the habitable parts of the world have been entirely transformed. Over large areas the wild vegetation has been removed and the physical, chemical and biological properties of the soil have been altered. From the hundreds of thousands of different kinds of wild plants, a few hundred have been chosen, drastically altered by breeding and selection for some specific purpose, and then multiplied prodigiously at the expense of others. The course of evolution has been changed and its tempo immeasurably increased. None of Man's more recent activities is likely to cause such rapid changes over so much of the earth's surface, and none has greater potentialities for affecting his future, for good or ill.

By his industry as a farmer, Man has permitted the human population to expand enormously. So far he has succeeded in providing enough food to prevent general famine, but this has been done largely by continually increasing the area of land under crops. The increase in total production has tended to obscure the fact that his interference with the previous biological balance has had many undesirable consequences that keep yields below what they could be. There are still areas that produce little or nothing of value to human beings ; some of these will certainly have to be brought into cultivation, and these possibilities will be discussed later in this series. But the total area of land is limited and, to increase food in the future, we must look less to increased areas under crops and more to increased yields per area. Research for plenty now calls for a better understanding of the causes of soil erosion, depletion of fertility, and the recurrent outbreaks

of pests and diseases, so that the immense losses they now cause may be prevented.

My main concern is with the effects of agriculture on the incidence of infectious diseases, those caused by the microscopic fungi and bacteria and by the ultra-microscopic viruses ; but the same general principles that control the incidence of these pathogens (disease producers) hold also for most insect and other pests.

Domestication Upsets the Biological Balance

When so much has been changed by agriculture, it would be futile to discuss what has been changed most, but few things can have been affected more greatly than the evolution of pests and diseases. Evolution is usually considered to be a ponderous process that acts to produce changes on a time scale measured in geological periods rather than in human lifetimes. This *was* true before agriculture was invented, but it isn't true now. Under domestication, the kinds of plants that predominate in any region can change with startling rapidity ; and with them, after only a small time-lag, the prevalent pests and diseases change too.

Until men started to move plants from their native homes to be cultivated in other districts, the vegetation in any district was reasonably stable. It consisted of species that had slowly become adapted so that they were in some kind of equilibrium with their environment and with one another. Their only essential requirements were that they competed sufficiently well with their neighbours to survive, and one important qualification for survival was that they were not too severely affected by local pests and diseases. Plants growing in the wild become diseased, and diseases have doubtlessly limited wild species that otherwise might have predominated. But in most natural habitats, diseases do not have an easy time. Their activities are greatly restricted because most viruses and pathogenic organisms have limited host ranges—that is to say, they can infect only a few kinds of plants—and the vegetation in most wild habitats is a mixture of many different kinds. If one plant becomes infected, its neighbours are probably different kinds and not susceptible to the same pathogen, so that each victim has to be found and attacked singly. Growing a crop means replacing variety by quantity, and this tips the scale far over in favour of the pathogens. It increases the number of potential victims in a given area, and so makes it easier for one to be found, and this victim is surrounded by others all susceptible to attack. Spread, instead of the chance business it was, becomes almost a certainty.

When agriculture started, the plants first cultivated must have been those native in the area ; for instance, wheat in the eastern Mediterranean. They were chosen for some character that attracted the attention of the intending farmer, and were probably oddities, or even monstrosities. Almost certainly they were rarities that were not faring too well in the wild. They would not have been widely exposed to pathogens, so that the most susceptible races would not have been culled by natural selection. These unadapted plants were taken, freed from competition with more vigorous ones, and their numbers rapidly increased. This provided their potential pests and diseases with a free field to develop their activities. That they wasted little time is shown by reference in books of the Old Testament to crop diseases, and by the fact that in the Roman period an annual festival (the Rubigalia) was held, at which the help of two gods, Rubigus and Rubigo, was invoked to protect the crops of wheat from rust diseases.

No. 3. CONTROLLING PLANT DISEASES

The need for protecting crops from diseases has progressively increased as agriculture has spread over ever wider areas, and as plants have been moved in increasing numbers to areas remote from their homes. The future of a species, either plant or animal, newly introduced into a region, is something about which forecasts are never safe. Several things can happen. Conditions may resemble those in the region from which it came, and then it will continue much the same and suffer the same diseases. It may meet such adverse conditions—either climate or some virulent disease to which it was never previously exposed—that it soon fails. Or it may find conditions that suit it, perhaps much more favourable than in its original home, and a region relatively free from important parasites and predators. Then it may flourish to an extent unknown before : the potato in Ireland, rubber in Malaya, and the rabbit in Australia, are examples of this kind of thing. The period of well-being and rapid increase, however, is usually a temporary phase. Sooner or later parasites and predators from its old haunts catch it up, or some local ones become adapted to attack it. Then there can be disasters such as the historic outbreak of Potato Blight which led to famine in Ireland during the 1840s, or the current destruction by virus diseases of cocoa trees in the Gold Coast.

Modern Practices Assist the Spread of Disease

Periods of freedom from major diseases are likely to be fewer and to last for shorter periods in the future. The increase in travel and the growing world-wide traffic in plants combine to make it about as easy for pathogens now to spread from continent to continent as it used to be from county to county. This not only increases the area over which already known diseases occur, but it may also produce what are, in effect, new diseases. The spreading of viruses, fungi and bacteria from one region to another brings them within reach of new kinds of plants, some of which they may be able to attack ; and it also takes them into new environments which may allow them to spread more rapidly and cause more severe effects than previously. The mere juxtaposition of a pathogen and a susceptible crop is not enough to lead to an outbreak of a disease ; this happens only if the climate and the conditions of the crop also favour the multiplication and spread of the pathogen. In this country, for instance, unless potato crops have been sprayed with a protective fungicide, they become blighted after wet or muggy spells, but not when the weather is fine and dry. No generalizations can be made about the effects of weather on disease, for diseases are individual things, and different ones are favoured by different conditions. Their different regional distributions, and fluctuations in prevalence from year to year, mainly reflect their dependence on a certain kind of environment.

The movement of living plants around the world is perhaps particularly likely to lead to outbreaks of new virus diseases. This is because symptomless carriers of viruses occur commonly, so that plants of one kind that are perfectly normal in appearance often contain viruses that can cause serious diseases in another kind. Other features of modern agriculture will also favour the increase of virus diseases unless they are appreciated and countered. One is the heavier manuring now practised, because viruses spread more rapidly in well-fed crops than in starved ones. Another is the tendency of growers, in their search for uniform products of high quality, to propagate an increasing number of crops vegetatively instead of from seed. No better method of spreading viruses could have been developed. When a virus infects a plant it usually invades all the vegetative parts—roots, stem and

leaves—and remains active in them as long as they remain alive. But the viruses rarely pass into seeds, and the sowing of seed from infected plants generally produces healthy seedlings. The propagation of infected plants by vegetative tissues, such as tubers, bulbs, corms, runners or cuttings, will perpetuate the viruses and give rise to infected plants. Plants, unlike animals, once infected with viruses never recover ; they remain infected indefinitely, and they can also continue to contract further viruses. The accumulation of more and more viruses with increasing age explains the decline in cropping power that occurs in varieties of most kinds of vegetatively propagated plants; this decline has long been recognized and described under such terms as degeneration, senility or running out, but attributed to a supposed weakening effect inseparable from sexual methods of reproduction. This interpretation is understandable because the invigorating effects of sexual reproduction on degenerate lines of such plants as potatoes can be dramatic, but they occur solely because reproduction by seed gets rid of the accumulated debilitating viruses. The lines of many crop plants that are extensively propagated today are in a condition that would be paralleled in a man who continuously and simultaneously was suffering from mumps, measles, chicken-pox, and the common cold. Small wonder they yield poorly, and there is probably no single measure of disease control that would more rapidly increase yields than their replacement by virus-free stocks.

Improving the Health of Crops Such a step would be one hygienic measure among the many needed to improve the health of crops. If we are to get the increased yields the world needs, the well-being of crops will have to receive far more attention than it has up to now. Life in towns and cities became tolerably free from plagues and pestilences only when sanitation and hygiene were treated seriously. Overcrowding in crops far exceeds anything that happens in towns, yet most are left to take their chance with no attempt to destroy sources of infection or to protect them from the almost inevitable consequences. This is so despite the fact that control measures for many diseases are known, and their practical value is regularly demonstrated by the high yields obtained by those progressive growers who use them. The study of plant diseases is a relatively new science. It has already achieved much, but more skilled workers are needed if the balance between plants and diseases, which has been so drastically changed by agriculture, is to be restored and maintained in favour of the cultivated crops.

More plant pathologists are wanted for two reasons. First, there should be more working as general practitioners among the crops, to diagnose the diseases and to advise on the use of already-known control measures. Many of the present losses could be avoided by such precautionary treatments as seed disinfection, a correctly chosen rotation of crops, a protective spray or dust, the use of a variety bred for disease resistance, or by selecting virus-free lines for propagation. But these practices will not become general unless there are trained people to adapt them to local conditions and to demonstrate their value in increasing yields. Also, only by having more pathologists observing the world's crops is it likely that outbreaks of potentially serious diseases will be noticed early enough to be eradicated or prevented from spreading widely. In too many countries plant diseases go almost unnoticed, and quite unstudied, until they have spread so widely as to threaten the survival of an important crop. Crop diseases, like forest fires, increase geometrically with time, and, like fires, are more easily dealt with at the start than later. Avoiding a catastrophe is less spectacular than

overcoming one, but it is much more economic; the main hope of avoiding disastrous outbreaks in the future is to increase the number of people who are looking for them, and who are skilled in combating them.

Secondly, more pathologists are needed to study the diseases for which there are as yet no adequate control measures. Perhaps the most important among these are the virus diseases of perennial plants grown as orchard or plantation crops, but there are also many soil-borne and wind-borne pathogens against which better protection is needed. Past experience provides ample evidence that preventive measures can be found and that their discovery will abundantly repay the cost. A shift is needed in the emphasis in plant breeding ; in producing varieties for high yields or quality, what measure of disease resistance the wild parents possessed has often been lost. The cheapest method of disease control is to grow immune plants, and losses could be lessened by making disease resistance a first essential when parent plants are selected to breed new varieties. This alone will not achieve our ultimate goal of healthy plants ; plant pathogens are shifty enemies and as capable of change as the plants they attack. When threatened in one way, they have an unhappy knack of reacting by producing new forms that can penetrate the latest crop protection. But this is no reason for despair. It means simply that protection must be treated as a continually evolving process, in which the pathologists try to keep one jump ahead of the pathogen.

Lack of Balance in Scientific Research Although the ideally healthy crop may be a long way off, work on crop protection could reduce the large losses now suffered. But this will not happen unless trends in research alter. Science tends to become increasingly lop-sided, with biology getting too little support and too few of the best research workers. Most other branches of science have been more favoured, with the result that the world is threatened with the absurd position of a huge human population supplied with medicines to prolong their lives and intriguing gadgets to while away their time, but in grave danger of lacking the one essential commodity—food. It was perhaps to be expected that man should consider his own health and nostrums, and even his physical comforts, amusements, methods of travel, and armaments, more important than the health of plants, but it is high time he recognized that all other things are secondary to the production of food.

With only limited new areas for agriculture now to penetrate, the future depends mainly on increasing yields per acre. Only this way, too, can the peasant's standard of living be raised above the subsistence level. It can be done by irrigation, by better manuring, and by protecting the high-yielding crops from the depredations of pests and diseases, but it will be costly and will call for study by the best research workers. It is not a simple problem in technology, but one that calls for a detailed study of such fascinating problems as the way in which parasites evolved from harmless organisms (evolution of parasitism), the nature of disease resistance, and the origins of viruses. There is no lack of stimulating challenges ; on their acceptance and solution, the well-being of future generations may depend.

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INCREASING AGRICULTURAL PRODUCTION IN THE O.E.E.C. COUNTRIES

A. P. JACOBSEN

Strenuous efforts are being made by the Organization for European Economic Co-operation to bring about a substantial increase in the productivity of industry in Europe. The writer, who is the Danish delegate to the O.E.E.C. Food and Agriculture Committee, outlines some of the ways in which agricultural output may be further expanded, and calls upon individual farmers to examine their own methods to see what part they can play in this international movement.

IT has long been realized within O.E.E.C. that it will be necessary for the member countries to make more serious efforts than they had so far done to increase production in Europe, and on August 29, 1951, the Council adopted a declaration that the broad objective of Government policies will be to expand production by 25 per cent over the next five years. Agriculture is to play its part in this effort, and it may therefore be appropriate to consider the possibilities of increasing agricultural production in the participating countries.

In 1950, the eighteen countries participating in O.E.E.C. together had 262 million inhabitants and an agricultural area of 202 million hectares (780,000 sq. miles), made up of 88 million hectares of arable land and 114 million hectares of permanent grassland. Of the arable land, 40 million hectares were sown with grain, 1.28 million with sugar beet, 4.15 million with potatoes, 2.8 million with fodder roots, and 16 million hectares were under temporary grass. Of the large area of permanent grass, 40 million hectares were good or fairly good grassland, and the remaining 74 million were classified as rough grazing, of which 45 million were in Turkey, 10 million in France, 7 million in the United Kingdom and 5 million in Greece.

Means of Increasing Production An increase in crop production (including grass), which should, of course, be the primary aim, can be achieved in a number of different ways. First, in all countries, considerable areas of waste land can be, and are being, reclaimed for agricultural use. But, at the same time, agricultural land is being taken for buildings, roads, sports grounds, airfields, etc., to such an extent that the loss makes up for or even exceeds the new agricultural land obtained by reclamation.

Secondly, it can be achieved by higher crop yields. The fact that there are holdings in all countries which have obtained yields of up to 50 per cent more than the average for soils of equal quality shows that large increases in yield are possible. This applies equally to grain, roots, clover and grass, and it applies to countries where the yield is comparatively high as well as to those where it is usually low. The increase may be obtained by better treatment of the soil, heavier manuring, the cultivation of higher yielding varieties and strains, the control of weeds and diseases, and by taking more care in methods of harvesting and crop preservation for fodder. Of all these, however, perhaps the surest way of securing an increase is by the use of larger quantities of fertilizer.

A third possibility exists in the extended cultivation of higher yielding crops. Agriculture is a complex organization and the best economic result is seldom, if ever, obtained by concentrating on the cultivation of one or two crops, but rather by seeking the correct balance between areas, each

growing different crops. The general aim should be a gradual shifting to the higher yielding crops, and particularly to ploughing permanent grassland to arable land, extending the areas under roots at the expense of fallow, grass and grain, and substituting one- or two-year leys for the longer leys normally practised in some places.

Finally, there is scope for extra crops, particularly in the autumn. Some crops, mainly grain, do not occupy the land for the whole of the growing season, particularly in those countries where the climate is conducive to a long season. Here, it is possible to cultivate an additional green fodder crop in the autumn for feeding in the fresh state or as silage or hay. Experience shows, however, that the yield of such stubble crops is not satisfactory in the northern territories, say, north of a line Hull to Hamburg. But south of this line the practice is of considerable value and might, with advantage, be extended. Something might also be gained north of the line by the sowing of cover crops, and ordinary grassland will often yield a valuable autumn crop.

Storage and Utilization The next steps to be considered are the storing of the crops, the uses to which they can best be put, and feeding methods. There is room for considerable progress in each of these three spheres. The crops, or parts of crops, which are not consumed in the field, are often exposed to heavier loss than is necessary ; and here better treatment and storage are tantamount to a larger harvest. Ensiling and artificial drying immediately come to mind.

The primary aim of agricultural production is the nourishment of man, which has, therefore, the first claim on grain, potatoes, pulses and vegetables. Industry, too, requires its quota for the production of sugar, beer and spirits, etc. (It should be mentioned in passing that sugar production, which is entirely inadequate within the O.E.E.C. countries, is limited by the capacity of the factories). The rest of the arable production is used almost entirely as feed for animals. It follows, therefore, that by the greater use of mechanical power more land can be released for human food crops.

In the countries here dealt with, a very large proportion of the crops are used as animal feedingstuffs (about 90 per cent in Denmark), and it is thus extremely important that feeding should be planned in the most advantageous manner. Of course, usage depends not only upon good husbandry, but also upon the nature and quality of the animals. Without going into details, I only want to point out that the feeding may be so poor that the whole crop may be spent on maintenance, and there will be no production at all. On the other hand, with efficient feeding and good animals, about 20 per cent animal products may be obtained, a little more in the form of milk, something less in the case of eggs, and still less in beef. It must also be remembered that pigs and poultry mainly require grain, whereas cattle and sheep can be fed on other fodder crops.

A Gigantic Task Theoretically, the substantial production increase aimed at in the course of five years is surely possible, but because of the complexities of the general economic situation, it is extremely doubtful whether it can in fact be achieved. However, in order to form an opinion on this it may be useful to consider the tempo of the increase in agricultural production which has taken place in recent years in Denmark. Here the total crop production has, for all practical purposes, been doubled between 1900 and 1950. This corresponds to an annual increase of 1.4 per cent. It therefore appears that, computed over a number of years so as to offset

the fluctuations due to seasonal variations, an increase of about 1.5 per cent from year to year may normally be anticipated. To this must be added the saving in horse feed made by mechanization.

Animal production should indeed be increased more quickly than the quantity of feed. Better feeding and better domestic animals should increase productivity. The best measure of this would be to compare the yield today of milk, pork, eggs or beef per 100 feed units with that of twenty to thirty years ago but, unfortunately, no reliable data is available on which to base the calculations. Nevertheless, computations may indicate that the rise is not more than one-third per cent annually.

It will be understood from the above that a substantial increase in agricultural production during the course of five years is a gigantic task. It has therefore been pointed out in O.E.E.C. that such an increase in production is possible only by the establishment of more intensive advisory services, a higher consumption (or increased usage) of fertilizers, and increased use of machinery and other means of production, larger investments, extended credit facilities, reasonable guaranteed prices, removal of trade barriers, adequate price relations, and support by public opinion.

The decisive factor, however, is that each farmer should apply his whole energy to the problem. Every farmer knows, or can easily find out, how this increase can be brought about, and it is up to him to consider what possibilities of improvement there are on his own holding. There is every indication that there will be a good market for the produce, and in practically every case the potential output of most holdings is considerably above present production.

The increase in production as outlined above, does not imply increased imports of grain. Indeed, it looks more certain than ever that foreign grain will be scarce and dear for many years to come. It is this fact, coupled with the prices of animal products, which makes it advantageous to devote more capital and energy to an increase in domestic production.

Farming Films

The Scientific Film Association has recently issued a provisional list of over 750 films on various aspects of farming, forestry, gardening and beekeeping both in Great Britain and overseas. This catalogue gives full details of title, gauge, running time and source, and is free to members of the Association. Non-members may obtain copies from the Secretary of the Association at 164 Shaftesbury Avenue, London, W.C.2, price 2s. 6d. (2s. 9d. by post).

EXPERIMENTAL HUSBANDRY FARMS: REVIEW OF PROGRESS

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IN last month's issue of the JOURNAL, I gave an outline of the plan to set up experimental farms, and described some of the features of the nine farms on which experiments are in progress. I want now to review these experiments and give some indication of possible lines for future work. For ease of reference the locations and soil types of the farms are stated again. They are : Boxworth, Cambs—boulder clay ; Bridget's, Hants—chalk ; Gleadthorpe Grange, Notts—Bunter sand ; Great House, Lancs—boulder clay ; High Mowthorpe, Yorks—chalk ; Kirton, Lincs—silt ; Rosemaund, Hereford—Old Red Sandstone ; Terrington, Norfolk—silt ; Trawscoed, Cardigan—medium loam.

Long-term Crop Experiments The long-term experiments are of interest alike to farmers, research workers and advisers. Once the precise detail of an investigation has been agreed, it is laid down on those farms where the treatments fit in with the normal system of husbandry. A similar layout, but with minor modifications to suit local practice, is used on each farm, so that eventually it will be possible to obtain a measure of the effects of soil type and climate on the value of any particular treatment.

Much has been said and written on the fertility building power of the ley, but, as yet, we have little precise information on its value. It was decided to supplement the work now being carried out at the Grassland Research Station, Rothamsted, Woburn, Cambridge University, Jealott's Hill and other centres by an experiment under a still wider range of soil and climatic conditions. At six of the farms—on sand, chalk, clay and loam soils—an arable rotation is being compared with : (1) a three-year ley grazed each year ; (2) a three-year ley from which all the produce will be conserved ; (3) a three-year lucerne ley grazed and mown ; and (4) long-term grass grazed each year. The influence on soil fertility will be measured in each case by three testing crops—potatoes, wheat and barley. Sub-treatments include two levels of nitrogen for the leys and the arable crops, and a contrast between farmyard manure and no farmyard manure for the first testing crop, potatoes. Lime (if required) phosphates and potash are being applied regularly to all plots to ensure that a lack of these plant foods is not a limiting factor in crop growth. Yield figures will not be available for a few years, but visitors have already found much of interest in the experiment. Many have expressed the desire to watch its progress year by year.

Should straw be ploughed-in, removed, burned or returned to the land as farmyard manure ? This is no new problem either to the farmer or the research worker. Many will be familiar with the valuable work on this subject carried out at the Norfolk Agricultural Station and Rothamsted. We are following up that work by testing out these different ways of using or disposing of straw on boulder clay, sand and chalk soils. Here again, as in the case of the ley fertility experiment, we are endeavouring to act as a link between research and farm practice. This experiment has already attracted attention by visiting parties of farmers, and is a subject of lively discussion. Nevertheless, there seems general agreement, even among those who hold

definite views as to the ultimate result, that it should be continued over a long term of years.

Few farmers and advisers talk of deep ploughing without thinking of Dr. E. W. Russell of Oxford, whose ploughing experiments are now so well known. He is interested in depth of ploughing experiments on four of our farms, covering chalk, clay, sand and loam soils. On these farms we hope to make rather more careful determinations of the effects of different depths of ploughing. In particular, we wish to examine the relationship between different types of ploughing and their effects on the optimum dates for subsequent cultivations and sowing.

Are there measureable residual effects from phosphate and potash applications ? If so, do they vary with soil and rainfall ? Are there differences according to the type of phosphate used ? What are the long-term effects of fertilizer applications ? These are questions of general interest : their answers are also of particular importance to the N.A.A.S. and its soil chemists. At five farms, superphosphate, ground mineral phosphate, basic slag and dicalcium phosphate are being compared. Some plots get relatively small dressings each year, others larger dressings at less frequent intervals. At four farms, low and frequent applications of potash are also being contrasted with higher and less frequent treatments. Then there is a rotation experiment in which individual plots are treated each year with N (nitrogen) ; P (phosphate) ; K (potash) ; NP ; NK ; PK ; NPK ; farmyard manure ; farmyard manure and NPK. Already this and the residual phosphate experiments are providing useful demonstrations of the importance of fertilizers in higher crop production.

Short-term Crop and Grass Experiments For some years the N.A.A.S. has been conducting variety trials in co-operation with the National Institute of Agricultural Botany. It was evident that some of the farms would cover soil types and conditions not available to the N.I.A.B. on its outstations or through county trials. So we agreed to assist where possible. A number of the farms carry wheat, barley, oat, pea, potato, sugar beet and fodder beet variety trials, which prove a constant source of local interest.

One of the more important types of short-term experiment is not, however, a straightforward variety trial, but the investigation of some local problem, probably thrown up by a Farm Advisory Committee. I should like to mention three such investigations to illustrate what is being done.

It is the practice of some Wold farmers to lime their land at regular intervals. On first thought this seems a curious practice, even if we concede that there are a few gravelly patches on the Wolds which are sour and do respond to lime. The Farm Advisory Committee of High Mowthorpe was convinced that this apparent conflict between the farmer and the scientist should be solved, and so two liming experiments have been laid down—one on a soil which chemical analysis shows to be well supplied with lime, the other on a gravelly soil. The second experiment is taking place on the blow-away sand land at Gleadthorpe Grange, where it might be expected that restorative crops would play a big part in successful arable crop production. Here, a comparison is being made of the value of lupins, one year's seeds managed in various ways, and the undersowing of cereal crops with trefoil and Italian ryegrass. Then, thirdly, there is a local problem in Lancashire. What is the best management and treatment for grass on a naturally lime and phosphate deficient soil in a high rainfall area and

subject to heavy smoke pollution ? We have made a start on this problem both on leys and permanent grass. A study is also being made to find those species of grasses and clovers which are most tolerant and productive under these rather abnormal conditions.

Some Livestock Problems Experiments with animals are usually more difficult to plan and carry out. New or adapted buildings may be necessary ; more continuous and detailed supervision is needed ; and the cost is often higher. A promising start has been made in spite of these difficulties.

At three farms we are rearing dairy heifer calves and yearlings on two planes of nutrition—medium and high. The experiment is rather similar to the one on beef cattle conducted by W. S. Mansfield and A. J. Brookes at the Cambridge University farm. Stated in the briefest terms, we wish to find out if it is better to rear calves and yearlings on a high plane of nutrition and calve them down for the first time at an early age, or to feed on a lower plane and calve down when older. Autumn-born calves are being used at each of the three farms—Ayrshires at Bridget's, British Friesians at Boxworth, and Dairy Shorthorns at Trawscoed. No experiment of so complex a nature ever runs quite according to plan, but so far the more serious difficulties have been overcome, and the staff and farm workers are gaining valuable experience. It is hoped eventually that, over a three-year period, ninety-six calves of each of the three breeds will be reared. Records are being kept of liveweight gains, measurements of height, girth, etc., and of the health of the calves. Each animal will be milk recorded from the time it first comes into the milking herd.

A further experiment is concerned with a possible link between milk and beef production. It seems that many of the calves to be reared for beef will be those surplus to the requirement for replacements in our dairy herds. Some will be steer calves of dual-purpose breeds and heifer calves out of the poorer producers ; many others are likely to be the progeny of poor-yielding cows, or of heifers which have been mated to colour-marking bulls of beef breeds. At two farms, groups of such pure-bred and cross-bred calves are being fed for beef. They include British Friesian and Dairy Shorthorn calves, crosses of these breeds with Aberdeen Angus and Hereford bulls and also Aberdeen Angus × Ayrshire and Hereford × Ayrshire. The calves are purchased in autumn, reared by the multiple suckling method, and kept moving until they are fit to grade for beef. Detailed records and measurements are kept of each group, and the carcasses will be examined for quality.

With pigs, a reciprocal crossing experiment has been started at Kirton and Terrington using the Essex and Large White breeds. The aim is to show whether cross-bred vigour is measureable in terms of prolificacy, quicker liveweight gains, economy of liveweight gains and carcass quality. It is hoped to repeat this experiment at Trawscoed using the Large White and Welsh breeds.

Two experiments to test the value of antibiotics for fattening pigs are now nearing completion. Aurofac 2A and procaine penicillin with a vitamin B_{12} supplement were fed in rations containing all vegetable protein and part vegetable and part animal protein. The experiments were two of several designed by the Agricultural Research Council, and devised to obtain speedy information on the value of antibiotics for fattening pigs. Now, follow-up work has started to determine at what stage in the life of the fattening pig the antibiotic supplement is of most value.

The first large-scale poultry experiment is now in its second year at Gleadthorpe Grange. Birds on four different rations are being tested under four distinct methods of management—fold units, colony houses, batteries and deep litter houses. Records are being kept of egg yields, egg quality, mortality and general health.

At Trawscoed, rations containing condensed fish and whale solubles and all vegetable protein are being compared with a ration including fishmeal for egg production.

Apart from these more detailed experiments, a number of studies are being made on a wide range of subjects. With sheep for example, some work is in progress on the types of birth coat of lambs and their correlation, if any, to good or bad characteristics of mature sheep ; a comparison of lambs of various crosses ; the influence on lamb growth of rearing at high, medium and low altitudes. Some interesting observations have also been made on the feeding of high-quality hay and silage to dairy cows as a preliminary study possibly leading to more definite experiments.

Future Experimental Work I have followed a fairly common practice in describing crop and grassland experiments first, and then livestock experiments. In doing so, I have possibly exposed a weakness in our experimental programme—the need for a closer link in our experimental work between crops and grass and livestock. Animal products figure very largely in the production of our farms, and an increasing amount of our milk, meat and eggs is now derived from crops and grass. It follows that a search for the best and most economical methods of converting vegetable to animal products has become of supreme importance.

A good deal of thought is being given to devise suitable experiments to extend our knowledge. Possible lines for future work are : grazing management in its many phases—spring, summer and winter, outwintering and inwintering of cattle, the best types of fodder crops, for example, kale and fodder beet, and the best way to use them, and the feeding value of conserved grass products. Some of these problems may best be tackled by observation studies both on the experimental farms and on widely scattered private farms ; others may be more suitable for study by critical experiments ; still others may be more appropriate for fundamental research. Here, I can indicate that the Experimental Husbandry Committee is alive to the need for increased facilities to take on selected sections of these important fields of work.

Visits to Experimental Farms Many intending visitors were disappointed when we had to cancel farm visits last year because of the risk of spreading foot-and-mouth disease. We hope to be able to welcome visitors to Experimental Husbandry Farms this year and to show them the experiments to which it has been possible to make only a brief reference in this summary. Early in the summer of 1953, a farm guide will be issued for each farm. These will contain detailed information on all the experimental work in progress.

THANKS TO THE COLORADO BEETLE . . .

E. C. LARGE, B.SC., A.R.I.C.

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The European Plant Protection Organization has called together an international working party of scientists to review the host of plant import and quarantine regulations now in force in European countries, and to suggest how they might be made more effective in keeping out unwanted plant pests, and, at the same time, less restrictive of trade. This article gives the substance of the first three reports of the working party.

ONE of the cherished memories of my life is that of tramping through mile after mile of potato drills at Broadwoodwidger in Devon in 1941, helping in the search for Colorado beetles that might have dispersed from the colonies found there in that year. And I shall always remember, too, how all the assembled inspectors and entomologists of the Ministry of Agriculture were sent flocking post-haste across Devon to another outbreak, at Clyst St. Lawrence, through the perspicacity of a Devon schoolboy, who found some beetles, which he saw were like the pictures, and took to his schoolteacher. Those invading beetles were completely mopped up and their progeny was destroyed. I thought at the time, and I think still, how lucky I was to have seen that defensive action, for it was a little knot in one of the vital threads of agricultural history in this country.

The whole of the organized work of the old Board of Agriculture on pests and diseases of crops really arose out of the great Colorado beetle scare of 1875. And it was then that the first coloured pictures of the beetles, and the stories of the havoc they caused in the U.S.A., began to diffuse among the English public. Later, after the nasty scare at Tilbury in 1901, it was again the Colorado beetle that began the setting-up of the whole rubric and fabric of our Destructive Insects and Pests Acts. It was then that our naturalists and our legislators began to say : " if we are going to deny the Colorado beetle the freedom of our ports, why not some of the other dangerous foreign plant pests and diseases that we certainly do not want here?"

But we have to thank the beetle for far more than that. It has served as a conspicuous herald of a whole horde of potential invaders ; distinctively striped and coloured and with its fat red grubs, big enough to be easily seen, it has been an obvious enemy ; we can all understand the damage it might do ; we can all join in the search for it ; and successive scares have had the effect of rousing our whole population to a kind of sporting determination not to let the beetle establish itself in Britain if that can by any means be avoided. It has been the part of scientists to plan our defensive strategy, with specialized entomological knowledge that few can share, and so far this strategy has been successful* ; but it could never had been so but for the co-operation of the public. The Colorado beetle has drawn us all together in a resolve to keep it out, and what is more, it has given us all some realization of the importance of defensive measures against alien pests and diseases in general.

* An account by Dr. I. Thomas, of the Colorado beetle in England, in relation to its spread on the Continent, appears in the December issue of *Plant Pathology*.

THANKS TO THE COLORADO BEETLE

E.P.P.O. Starts Work Now, it seems, the Colorado beetle, or the dislike of it, has brought about something else that is all to the good—this time in the international field. Since 1947 an International Committee under the chairmanship of an Englishman, Dr. V. E. Wilkins (formerly of the Ministry), has been concerned with campaigns in several European countries to control the Colorado beetle by spraying, and so reduce the harm that was done by letting it get established there. Arising out of good progress with this work, when it was done on an international basis, it was decided in 1950 to bring into being a new permanent European organization, not only to continue with the Colorado beetle control, but also to advise and assist European governments on the control of all plant pests and diseases where international action was called for. This body, called the European Plant Protection Organization (E.P.P.O. for short) was inaugurated in Paris in the spring of 1951, and Dr. V. E. Wilkins became its Director-General.

The first piece of work which E.P.P.O. found to be needing its attention was that of making an independent and strictly scientific review of the quarantine and other legislative measures that had grown up in the several countries of Europe, for the real or ostensible purpose of preventing the import of dangerous pests and diseases from one country into another. Many of these regulations were well drafted, fair and necessary ; others seemed too wide in their scope, practically impossible of fulfilment, biologically dubious, or unnecessarily restrictive of trade. The work was tackled by calling together a working party of very experienced plant pathologists and entomologists, notably those who were ultimately responsible for advising their governments on the biological aspects of import regulations, and then getting them to discuss the whole vexed business, frankly and honestly *as scientists*. Three reports of this working party have now been published (1), and they make interesting reading. The first, of February 1951, concerns quarantine measures against four specific pests and diseases of major international importance ; the second, of December 1951, concerns a number of the known dangerous pests and diseases which have not yet reached Europe, and appropriate measures for their continued exclusion ; and the third, of July 1952, lists a number of the pests and diseases which have gained a footing in Europe, with recommendations, where needed, on the best ways of preventing them from spreading any further.

Mr. W. C. Moore and Dr. I. Thomas, of the Ministry's Plant Pathology Laboratory at Harpenden, represented the United Kingdom on the working party, meeting and conferring with their opposite numbers from Denmark, France, Federal Germany, Holland, Italy, Switzerland, and Yugoslavia. The reports have been fairly widely circulated among the professional plant pathologists chiefly concerned ; others will wish to know only the gist of them. The principles underlying the drafting of rational import and export regulations have already been well set forth by Moore (2).

Means and Measures The main realizations running through all the reports, are that for legislative measures to be effective for pest frustration, each country must have an efficient plant health service, composed of well-trained men who are competent to recognize unwanted pests and diseases, and to issue certificates in which other countries can put their trust. All international measures of plant protection, like commerce itself, depend upon honesty, credit and confidence. Participating countries must have an honest resolve to report any new or dangerous pest, wherever

it may be found, with the safeguard that no other country will then impose permanent new restrictions on the entry of its produce unless or until the case has been properly investigated and some reasonable measure of restriction or prohibition has been shown to be necessary.

Given such technical competence and fair dealing, there are a number of measures that can be employed to prevent the spread of pests and diseases from one country to another, with little or no restraint of trade. These include : field inspections of the growing crops and the issue of internationally-recognized health certificates in the exporting country ; vigilant search for invaders in areas around docks and airports ; fumigation of plant stocks in exporting and/or importing countries ; post-entry quarantine, including graft testing ; avoidance of the shipment of soil with plant stocks ; seed disinfection ; avoidance of the use of hay, straw and grass for packing ; propaganda to familiarize all concerned with dangerous pests and the symptoms of their attack ; and only lastly, and in a very few cases, a complete embargo on the import of certain particular plant stocks or products from limited areas known to be definitely infested.

Potato Wart Disease and Root Eelworm Among the points made in the first report are : that there is no justification for requiring plants other than potatoes to be certified as free from WART DISEASE, as there is no known way by which such freedom could be determined ; that it is reasonable for importing countries to require that consignments of potatoes be certified as free from Wart Disease, after proper inspection, and also as coming from places where no Wart Disease has been found within a radius of about three miles ; and that the growing of potatoes on nurseries should be discouraged in the nurserymen's own interest, as it leads to difficulty is satisfying the regulations made by some countries, both for Wart Disease and Potato Root Eelworm. As to POTATO ROOT EELWORM : that if there *are* any countries where it is not already present, then it would be reasonable for those countries to put restrictions on the entry of potatoes and tomato plants (the host plants of the eelworm) but not on other plants ; that entry might fairly be restricted to the produce of land certified free from eelworm after sampling tests similar to those now adopted in Great Britain (which are already accepted by Canada and the U.S.A. as satisfying their very stringent quarantine regulations); and that the consignments should also be as far as practicable free from soil.

Colorado Beetle The working party finds no justification for restricting imports of potatoes, on account of Colorado beetle, into territories where the beetle is already established ; and no justification, anywhere, for restricting imports of produce other than potatoes during the hibernating period of the beetles. During the hibernating period the import of *potatoes* may involve some risk, but in this country we find it safe to import early potatoes under special licence during this period from some parts of the north of France where intensive Colorado beetle control work is being done under the guidance of E.P.P.O. We insist, however, on the potatoes being properly riddled and washed. During the active period of the beetles—spring to autumn—when there is a real risk of vegetables and other produce carrying the beetles, it is reasonable for importing countries to require a declaration that there has been no outbreak of the beetles within about thirty miles of the place where the produce was grown. No need is seen for restrictions on import of cut flowers, glasshouse produce, or quick frozen foodstuffs, and regulations should differentiate between such produce

as lettuce and cauliflowers which afford good "cover" for the beetles, and such things as peas, strawberries, tomatoes and bulbs, on which any beetles present can easily be seen.

San José Scale The other important pest considered in the first report—SAN JOSÉ SCALE—has now spread to many countries in Europe, and it could establish itself in all. As it may be introduced on nursery stock, it is reasonable to prohibit entry of such stock from districts seriously affected. From other districts, stock could be admitted subject to a satisfactory report from an adequate plant pathological service in the country of origin, and to effective fumigation. Fortunately, the pest can be killed on nursery stock by cyanide fumigation, and this does not harm the material. E.P.P.O. could act as referee as to thoroughness of fumigation in the exporting country, and this would often save the cost and trouble of the otherwise advisable precaution of fumigating again on import.

Pests and Diseases not yet Found in Europe Specific measures recommended in the second report, on pests and diseases not so far found in Europe, include : against PEACH YELLOWS, an embargo on the import of *Prunas americana* and *P. virginia*, with field inspection in the exporting country, and post-entry quarantine for all other stone-fruit trees ; against ELM PHLOEM NECROSIS and ROSE WILT, post-entry quarantine ; against POTATO SPINDLE TUBER and other potato virus diseases, field inspection in exporting country and post-entry quarantine ; against BEET CURLY TOP, the issue of a warning against import of beet plants, especially from infested parts of North America ; against the JAPANESE BEETLE (*Popillia japonica*), assurance that imported plants and bulbs are reasonably free from soil, in-port inspection and fumigation where the pest is found, with distribution of coloured pictures to assist in its recognition ; against APPLE MAGGOT (*Rhagoletis pomonella*), insistence that imported plants be reasonably free from soil, fumigation as against San José Scale, and avoidance of import of apples of lower than Fancy grade before November 15 ; against the PLUM CURCULIO (*Conotrachelus nemuphar*), a warning against import from North America of unripe stone fruit. Other diseases noted as potentially dangerous and referred for further study are virus diseases of citrus fruits, OAK WILT (*Chalara quercina*), and certain diseases of cotton.

Pests and Diseases in Europe but not yet Widespread Among the pests and diseases still found only locally in Europe, and dealt with in the third report, are four smuts of cereals, including FLAG SMUT OF WHEAT (*Urocystis tritici*), a warm climate disease reported in Mediterranean countries. These smuts are all under investigation, but, as they can be controlled by seed disinfection, it is unlikely that any import restrictions will be needed on their account. RED CORE OF STRAWBERRIES (*Phytophthora fragariae*), present in parts of England, Scotland and France, has now been found in the U.S.A., Canada and New Zealand. All countries would be justified in restricting imports of strawberry plants to those from nurseries where the disease has not been known to occur. CHESTNUT BLIGHT (*Endothia parasitica*), so devastating in North America, has recently become epidemic in Italy. It is also present in Switzerland, Yugoslavia and Spain. It is safe to import the nuts, and research suggests that importation of cut timber, without the bark, may also be safe. It is noted that the fungus also attacks oak. The O.E.E.C. (Organization for European Economic Co-operation), has published a full account of the disease, by Gravatt (3), which

provides the technical basis for import restrictions, and is now being considered by the European governments. Gravatt's report also deals with certain diseases of poplars, and is being considered by an International Poplar Commission, since the indiscriminate introduction of poplar cuttings may be dangerous. SOOTY BARK OF SYCAMORE, with *Cryptostroma corticale* now under strong suspicion as its causal fungus, has been found in Wanstead Park in Essex and on a few isolated trees in south-east England, as well as on sycamores in the Paris parks and near Grenoble. The disease is not found on nursery stock and does not interfere with international trade.

As to bacterial diseases, it is noted that BACTERIAL CANKER OF TOMATO is widely distributed and that it can be seed-borne. STEWART'S DISEASE OF MAIZE (*Xanthomonas stewarti*), found in the U.S.A., is now present in Italy. It is spread by flea beetles of a rare kind. Of much more importance is POTATO RING ROT (*Corynebacterium sepedonicum*). This disease, which reduces yield and causes severe losses in clamp, was in Europe in 1911 and was common in Germany until 1930, when growers there gave up cutting seed potatoes before planting. It caused a world-wide scare when it appeared in North America in 1931, and has since led to heavy losses over there. Potato Ring Rot was introduced into Switzerland with American potatoes in 1946, and may have reached Portugal by similar means. The salient point about the disease is that it does not spread appreciably or cause serious loss except when seed potatoes are cut before planting, as it is the cutting knife that spreads the bacteria from tuber to tuber. Nothing short of a complete embargo on the import of potatoes from infested countries can ensure keeping out the disease, but before contemplating such drastic action governments are advised to bear in mind that where seed is not cut before planting there is little risk of the disease becoming serious.

Virus diseases against which international action may be necessary, are numerous, but they are as yet often ill-defined. In general, the practicable measures for preventing their spread consist of competent inspection of the plants during the growing season, as well as at the time of export, and certification of freedom from virus symptoms. Post-entry quarantine, and graft testing, may also be advisable in some cases. STRAWBERRY YELLOW EDGE and CRINKLE are important diseases in Great Britain, and also, to some extent, in France. RUBUS STUNT has been recorded in Great Britain (where it is of especial importance on cultivated blackberries) and also in the Netherlands. LETTUCE MOSAIC has been recorded in Great Britain, Germany and Portugal, and probably occurs in the rest of Europe. It can be seed-borne and is spread by aphids. Governments are advised to ask for a certificate with imported lettuce seed to the effect that the seed crops have been inspected while growing and, within some prescribed and practicable tolerance, found free from symptoms. BEET LEAF CURL has been recorded in Germany and Poland but not so far in Great Britain. A certificate might be required with imported beet plants to the effect that they have not come from infested areas.

Three dangerous insect pests have been introduced into Europe in recent years. The FALL WEBWORM (*Hyphantria cunea*) is by far the most important of these. The caterpillars defoliate deciduous trees, then fall to the ground and continue their feeding on any of a wide range of agricultural crops. The pest has already spread to several countries of south-east Europe, where it has two generations in the year, and there is no biological reason why it should not survive anywhere in Europe, except perhaps in the extreme north. Effective import restriction measures would be difficult to devise as the insect can be transported with all kinds of produce, on all kinds of vehicles, and

at all times of the year. Fortunately, good control may be obtained by the use of modern insecticides. Goods from infested countries can be successfully fumigated with hydrogen cyanide or methyl bromide, but the practical measure is to stamp out outbreaks as they occur. No time should be lost in distributing descriptions of the pest so that it may be recognized promptly if and when it crosses the frontiers.

The TOMATO RUSSET MITE (*Phyllocoptes destructor*), found in Australia, Hawaii and California, has been reported in Spain and Jersey. It is a serious pest of tomatoes under high temperature and low humidity conditions, but can be checked by sulphur dusting. Certification that imported tomatoes have not come from infested nurseries would be justified. The BUFFALO TREE HOPPER (*Ceresa bubalus*), generally distributed in the U.S.A. and Canada, has been reported in Hungary, Yugoslavia, Italy, Switzerland and France. It is a pest of fruit trees, and can be effectively controlled by the use of insecticides. It would be reasonable to require treatment of plants for export with an effective fungicide, such as DDT, before dispatch from infested regions.

To Avoid Misunderstanding So much for the first three reports of the E.P.P.O. working party. Their many recommendations are *not* regulations ; they are advice tendered to the governments of all European countries on the ways in which their import and quarantine regulations could be drawn up with sensible regard to the nature and importance of the pests and diseases concerned. To what extent the governments will accept this advice I do not know. My part has merely been to review the three reports, and to give a fair indication of their substance. No doubt I have missed a few important points, and put a queerish slant on others. This article is not an official report, and to me it seems but another chapter of the story of how our bad bug, the Colorado beetle, in his heraldic dress striped black on yellow, pursuivant of all the legions of destructive insects, fungi, bacteria and viruses, has once again roused us to concerted action. It is only by good neighbourly, international action, such as that now being promoted by E.P.P.O., that we shall ever be able to defend at once our crops and our trade in this distracted world.

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FODDER BEET FOR PIG FEEDING

A COMPARISON OF DIFFERENT VARIETIES

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Is there any difference in the nutritive value of fodder beets of differing dry matter contents ? How do pigs fattened on a daily ration of 3 lb. meal plus fodder beet compare with those raised solely on meal ? The following report on the results of a 20-week trial in Hampshire provides some interesting information on both these important questions.

IN the face of the continued shortage of suitable pig meals, pig producers have had to pay more attention to unrationed foods, and amongst these fodder beet has come to the fore. Until recently, the most important of the unrationed foods have been swill, potatoes and, to a limited extent, mangolds, all of which have been used successfully when fed on the Lehmann system—that is to say, in conjunction with a small, fixed amount of meal. Under this system, the length of the fattening period is likely to be rather longer than on a ration of meal alone, but in terms of total food cost there is remarkably little difference.

Earlier work ([1,2,3]) has shown fodder beet to be much superior to mangolds for pig feeding—no doubt because the higher dry matter content of the fodder beet makes for a less bulky ration. This has led us to consider the relative merits of different varieties of fodder beet, since other workers([4]) have shown that wide variations exist in the dry matter content of the many varieties at present grown. A trial at Holbury Farm, East Tytherly, was therefore set up to find out : (1) whether there is any material difference in nutritive value between fodder beets of differing dry matter contents; and, (2) whether a basic allowance of 3 lb. meal per pig per day, unsupplemented by extra protein, would produce economic results comparable with feeding the same meal as the sole ration.

Three varieties of beet were used ; Hunsballe X, Yellow Daeno X and Red Otofte X. The first is a typical high dry matter beet, but is deep rooting and therefore sometimes more difficult to lift ; the other two are of medium dry matter content. Four pens, each of seven Wessex Saddlebacks, were made up by distributing the members of different litters between them so that each pen contained three gilts and four hogs. A week was allowed for the pigs to settle down before the experimental rations were introduced. The pigs were then fed the following daily rations :

Pen 1	.. ..	3 lb. meal with Hunsballe X to appetite.
Pen 2	.. ..	3 lb. „ „ Yellow Daeno X to appetite.
Pen 3	.. ..	3 lb. „ „ Red Otofte X to appetite.
Pen 4	.. ..	All meal, starting with 3½ lb. and increasing according to growth, as recommended in the Ministry's Bulletin No. 48 ([5]) (Control Group).

Samples of beet were analysed from time to time during the trial, and the amounts fed were adjusted to provide approximately the same total nutrients as were available to Pen 4. The analytical data relating to the three varieties of beet used is set out below. The meal fed throughout the trial was a proprietary National Pig Food No. 1 (sow and weaner ration) : no extra protein was added.

Analysis of Fodder Beet used in Trials

	Hunsballe X	Yellow Daeno X	Red Otofte X
Dry matter (*per cent*)	18.2	13.8	14.4
Crude protein in dry matter (*per cent*)	7.9	5.9	8.1
Crude fibre in dry matter (*per cent*)	7.0	8.5	6.6
Estimated starch equivalent in original (*lb. per* 100 *lb.*)	12.0	9.1	9.5
Estimated protein equivalent in original (*lb. per* 100 *lb.*)	0.72	0.40	0.98

All pens were fed three times a day, the meal in Pens 1-3 being put on top of the washed and sliced beet. The pigs receiving the beet had about half the amount of water which was given to those on meal only. The supply of Yellow Daeno and Red Otofte gave out after the trial had been running 119 days and, from then on, Hunsballe was used in their place. Accordingly, two sets of results are given—Table 1, covering the period from the beginning of the trial up to 119 days, and Table 2, the results from 119 to 140 days, when the trial finished.

Some Observations on the Results During the first two weeks the pigs in Pens 2 and 3 ate their beet more readily than those in Pen 1. Thereafter, all three varieties were eaten readily until the tenth week, when Pens 2 and 3 did not consume their theoretical requirement. The amount offered to these two pens was accordingly reduced to what the pigs would clear up, which, at the end of the 119-day period, was 18 lb. per head per day. The pigs in Pen 1 ate their theoretical requirements until the fourteenth week, after which the allowance was reduced to meet their appetites, and remained at 15 lb. per pig per day. Despite these reductions in the amounts consumed, liveweight gains were reasonably steady. The all-meal group was eating 6½ lb. meal per pig per day at the end of the 119 days.

During this first part of the trial, the control pigs on the all-meal ration appeared to be the fittest, and their pen was always drier than the others. Of the beet-fed pigs, the Hunsballe group seemed to be fitter than those on the other two varieties. The others, although healthy, never showed bloom. A week-by-week study of the growth rate of the pigs showed that Pens 1 and 2 kept up fairly well with Pen 4 for thirteen weeks, but thereafter fell slightly behind. Pen 3 had a slightly slower growth rate than any of the others.

Pigs were sent to the bacon factory when they reached just over 210 lb. live weight, and after 119 days on the experimental rations the average live weights of the pigs in each group, making due allowance for those already sent to the factory, were :

	lb.
Pen 1	213
Pen 2	207.7
Pen 3	202.5
Pen 4	222.1

Table 1

Summary of Trial Results (119 days)

	Pen 1 Meal plus Hunsballe X	Pen 2 Meal plus Yellow Daeno X	Pen 3 Meal plus Red Otofte X	Pen 4 (Control) All Meal
No. of pigs per pen	7	7	7	7
Total initial weight (*lb.*)	456	453	456	448
Average initial live weight (*lb.*)	65.14	64.71	65.14	64.0
Length of experiment (*days*)	119	119	119	119
Total live weight after 119 days (including pigs sold fat) (*lb.*)	1,498	1,454	1,417	1,555
Total liveweight gain (*lb.*)	1,042	1,001	961	1,107
Average liveweight gain per pig (*lb.*)	148.8	143.0	137.4	158.1
Total meal consumed (*lb.*)	2,400	2,340	2,400	4,243
Meal consumed per pig (*lb.*)	342.9	334.3	342.9	606.1
Total beet consumed (*lb.*)	8,640	8,910	9,210	—
Beet consumed per pig (*lb.*)	1,233	1,273	1,315	—
Average time fattening (*days*)	115	112	112	109
Average liveweight gain per day (*lb.*)	1.29	1.28	1.22	1.43
Conversion rate : Meal (*lb.*)	2.30	2.34	2.49	3.83
Beet (*lb.*)	8.28	8.90	9.56	—
Average cost of feeding one pig*	173s. 4d.	172s. 6½d.	177s. 7d.	197s. 6d.
Average cost per lb. live weight	13.97d.	14.4d.	15.5d.	14.9d.

* Calculated on the basis of meal at £36 10s. per ton (3.91d. per lb.) and beet at £5 12s. per ton (0.6d. per lb.)

As mentioned earlier, the only variety of fodder beet available from 119 days onwards was Hunsballe X, and it was therefore decided to continue using this variety only for Pens 1, 2 and 3.

Table 2 shows the results obtained with the pigs remaining from this point to the end of the trial. The pigs were sent to the factory on the same basis as previously, but all pens were cleared irrespective of weight after a further 21 days ; that is, 140 days after fattening began.

Table 2

Summary of Trial Results (119-140 days)

	Pen 1 Meal plus Hunsballe X	Pen 2 Fodder Beet	Pen 3	Pen 4 (Control) All Meal
No. of pigs per pen	3	3	3	3
Total live weight at 119 days (*lb.*)	615	586	525	568
Average live weight at 119 days (*lb.*)	205	195.3	175	189.3
Length of experiment (*days*)	21	21	21	21
Total live weight at 140 days (including pigs sold fat) (*lb.*)	668	656	617	656
Total liveweight gain (*lb.*)	53	70	92	88
Average gain per pig (*lb.*)	17.66	23.33	30.66	29.33
Total meal consumed (*lb.*)	120	120	160	329
Meal consumed per pig (*lb.*)	40	40	53.33	109.66
Total beet consumed (*lb.*)	600	600	800	—
Beet consumed per pig (*lb.*)	200	200	266.6	—
Average time fattening (days)	14	14	18.66	16.33
Average gain per day (*lb.*)	1.26	1.32	1.64	1.89
Conversion rate : Meal (*lb.*)	2.27	2.16	1.81	3.74
Beet (*lb.*)	11.32	10.79	11.41	—
Average cost of feeding one pig	23s. 0½d.	23s. 0½d.	30s. 8½d.	35s. 8½d.
Average cost per lb. live weight	15.6d.	11.8d.	12.0d.	14.2d.

Over the whole trial, the average time taken to reach 200 lb. live weight was : Pen 1—106 days ; Pen 2—110 days ; Pen 3—116 days ; Pen 4—105 days.

The conversion rates for meal and beet show that the most efficient return for total food consumed was obtained from the feeding of the Hunsballe X variety. For example, 10.8 per cent less meal and 18.0 per cent less beet were required with Pen 1 than with Pen 3 which was fed on meal and Red Otofte X.

No Significant Difference in Bacon Quality All the pigs used in the trial were sent eventually to the South Wilts Bacon Factory at Downton : none of the gilts was retained for breeding. A summary of the final dressed carcass weights, grading and grader's comments is given in Table 3.

Table 3

Quality of Bacon—Grader's Report

Pen No.	Average Dead Weight		Grading		Fat		Thickness of Streak	Proportion of Fat to Lean in Streak	Average Cash Return
			A	B	Firmness	Colour			
	score	*lb.*							£ s. d.
1	8	3	4	3	1 v. firm 6 firm	1 v. good 6 good	7 good	2 good 5 too fat	22 9 6
2	7	19	5	2	7 firm	6 good 1 dull	7 good	4 good 3 too fat	21 18 11
3	7	18	5	1*	2 v. firm 3 firm 1 soft	2 v. good 2 good 1 f. good 1 dull	7 good	1 v. good 3 good 2 too fat	21 11 5
4	7	17	5	2	7 firm	7 good	7 good	1 v. good 4 good 2 too fat	21 12 8

* No grader's comment on one pig.

From the above table, it will be seen that there was no significant difference between any of the pens as regards carcass quality. Except for one pig in Pen 3, the firmness and colour of the fat were good, and in every case the thickness of streak was good. The proportion of fat to lean in the streak was variable, and too much fat was in evidence among some pigs in all groups.

Economic Aspects For the last two years, fodder beet, regardless of variety, has found a ready market in Hampshire at £5–6 per ton of roots delivered to farm. Production costs, excluding storage, are approximately £50 per acre, varying with soil conditions, ease of lifting and other factors. It will be seen from Table 1 that for the first 119 days of the fattening period the following quantities of beet were consumed :

	Variety	Per Pen *lb.*	Per Pig *lb.*
Pen 1	Hunsballe X	8,640	1,233
Pen 2	Yellow Daeno X	8,910	1,273
Pen 3	Red Otofte X	9,210	1,315

An indication is given below of the anticipated liveweight gain obtainable from the produce of an acre of each of these varieties (when fed with the basal meal rations) by relating the above beet consumption figures to the crop yields determined from Danish trials ([5]) and the conversion rates obtained in the present work :

	Crop Yield (*tons per acre*)	Anticipated Liveweight Increase (*lb. per acre*)
Hunsballe X ..	19.76	5,342
Yellow Daeno X ..	25.62	6,446
Red Otofte X	23.38	5,478

Assuming, therefore, that crop yields under English conditions are similar to those in Denmark, there would appear to be sound reasons for a greater use of fodder beet in replacing meal for fattening pigs, and for growing the medium dry matter varieties, which not only seem to give a higher root yield, but are easier to lift.

Table 4

Cost of Food and Cash Return (140 days)

	Pen 1 (Hunsballe)	Pen 2 (Yellow Daeno)	Pen 3 (Red Otofte)	Pen 4 (Meal only)
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Total cost of food to fatten one pig	9 3 2½	9 2 5	9 10 9	10 12 9½
Average cost of food per lb. liveweight gain	14 0	14 3	15 2	14 9
Total cost of food per pen ..	64 2 5½	63 16 11	66 15 2½	74 9 7½
Total cash return per pen ..	157 6 9	153 12 7	151 0 3	151 8 7
Balance over food cost ..	93 4 3½	89 11 8	84 5 0½	76 18 11½

Summary

1. The growth rate of the pigs fed on fodder beet plus meal was only slightly less than that of those on the all-meal ration, indicating that a basal ration of 3 lb. meal, without extra protein, is adequate.

2. Only small differences in growth rates were found between the pens fed on the different varieties of fodder beet.

3. The food costs per lb. liveweight gain of the fodder beet pigs ranged from 94 to 102 per cent of the meal-fed group.

4. Bacon quality from the pigs fed on fodder beet was equal to that from the pigs fed on the all-meal ration.

5. Comparing the three varieties of beet, the highest dry matter variety showed some advantages in feeding value, but as a higher yield per acre is normally obtained from the medium dry matter varieties, it is quite probable that more bacon could be produced per acre of beet from these latter varieties.

We should like to express our thanks to Mr. H. S. Redshaw of Holbury Farm, East Tytherly, Hants, for facilitating this trial, and for his personal interest and active co-operation. Thanks are also due to the members of the N.A.A.S. staff in Hampshire who carried out the practical supervision from week to week.

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BALANCED FARMING AS THE KEY TO HIGHER PRODUCTIVITY

FRANK HENDERSON

Following his broadcast last year, we asked Mr. Frank Henderson to tell us something of his experience in running, in partnership with his brother George, for nearly thirty years, a small mixed farm on the thin soil of the Cotswolds.

WHEN my brother and I started farming nearly thirty years ago, all the work was done with horses and we aimed at getting a balanced system of farming on a farm which was in a bad state of cultivation. In the first year we had an output of £7 per acre (which, it may be interesting to note, was the average for the country as a whole at that time). We were satisfied with this, since with limited capital and a farm that had been badly farmed, we realized we could not expect to have a very great income, but it was obvious that we should have to increase our sales and at the same time build up the fertility of the farm. So we set a target of doubling the sales in five years. This was achieved, and it was then evident that we should have to start to mechanize our farming if we were to get a really high output in the following five years. Our new target was to again double the sales from the farm. The increase from £7 to £14 was not too difficult, but now we had to step it up from £14 to £28—a very different matter ! Each horse was consuming the produce of at least three acres, and we had four horses. As much as one-seventh of our land was being used to keep the horses, so we sold two horses and bought a second-hand tractor. We believed that the fuel for the tractor could be paid for by doing contract work for neighbours, and the 6 acres set free could carry more cattle.

Farming Blueprint At the same time we were slowly building up what we considered to be a balance not only between arable and grass but also a balance between one kind of stock and another. There is no place like a farm for the opportunity of waste, and we decided that we could cut out a lot of the waste by keeping different kinds of stock ; the waste from one lot of animals would provide, or create, food for another kind. Moreover, at the same time we were working with Nature and not against her, as the farmer who carries only one kind of stock is doing ; he runs a very great risk of disease and of a bad market for his one product. Our risks were spread and our losses from disease over all the years have amounted to almost nothing. This is, I feel sure, due partly to the fact that we realized very early that the proper way to run a farm is to start with a few good female animals and from them breed up the stock, buying only males from time to time. In this way not only was our knowledge always equal to our stock, but the stock was acclimatized to the farm and the management.

More stock made more manure, more manure made better crops, better crops provided more food for stock, and so a cycle was started that has gradually built up year by year until today we can carry a large head of stock and have practically no need of fertilizers. An example of what this naturally poor Cotswold soil will produce is shown by the lucerne this year (1952). Although a very dry season, it produced in four crops approximately 26 tons of food per acre, without fertilizers, but top dressed with poultry manure after each crop. It must not be thought that we have anything against fertilizers, but it is simply that with the balanced system of

This 15-feet high quarry face on neighbouring land clearly shows thin top soil typical of the land being farmed by the Henderson brothers, and (*below*) the high proportion of stone in the soil

Photos : *Frank Henderson*

Photos: *Frank Henderson*

Top: Clun Forest sheep grazing lucerne.

Centre: Some of the poultry rearing fields.

Bottom: Light Sussex on permanent grass which, as the result of close grazing with cattle and sheep, and the running of poultry, now carried ten times the stock it did thirty years ago.

Photos: *Frank Henderson*

Top: A bunch of Jersey heifers waiting to be let through an electric fence.

Centre: The second crop of lucerne cocked for hay. This field yielded 26 tons per acre in the season (4 crops). Manuring was confined to a top dressing of poultry manure after each crop had been cleared.

Bottom: A crop of Yeoman wheat, 1952.

Farm buildings as they were in 1927.

Photos : *Frank Henderson*

As they are today. All additions and alterations have been made by farm labour.

farming we have attained we do not need to spend money on them. We do, of course, spend quite a lot of time and money on handling farmyard manure. Even this expense has been greatly reduced in recent years by mechanization, and that brings me to another point : namely, that mechanization has been adopted by many farmers as a means of saving labour, but our approach has always been mechanization *to increase output per person employed.*

This can be seen from the mechanization of manure handling. For some years we found that we could load and spread from trailers about 1 ton per hour per man. Then we mechanized this job by buying a front-mounted tractor fork and a spreader and found that one man could load and spread 10 tons per hour. We had been spending about 600 man-hours a year on this job ; by mechanization we saved about 500 hours. Five hundred hours is sufficient time to look after 500 hens for a year, thus we could increase our flock by that number. Five hundred hens produce about £1,250's worth of eggs in a year, so by mechanization of the one job we could increase the output of another. The difficulty for most farmers in an example of this kind is that it takes a considerable amount of capital ; but we have been fortunate in more recent years to have sufficient capital for our farm. Whereas many farmers would have taken more land, we have been content to stay on the one small farm and try to produce the maximum from its 85 acres.

The Farm Budget In our farming we have always set ourselves a target and in doing that it has always been necessary to budget both for expenditure and income. As a result of this, I developed a very rough yardstick (which in recent years I have had the opportunity of applying to other farms) and since it does seem to interest quite a lot of farmers, it may be worth repeating here.

Capital invested in the farm—apart from the freehold value of the land—should not exceed the total production ; that is to say, a farmer who has £10,000 invested in his farming should see that his total production exceeds £10,000 a year. The amount spent on labour should not be more than 25 per cent of the total sales, so the farmer selling £10,000's worth of produce should not spend more than £2,500 on labour. Machinery cost (that is depreciation, fuel, repairs and hire of machinery) should not exceed 15 per cent of the total sales. That is £1,500 on the above figure, or alternatively the labour and machinery charge should not together exceed 40 per cent of sales.

If you look through almost any farm accounts you will find that the successful farms do achieve these percentages, but those that are losing money are the ones that are spending far too much on labour, and usually even more on machinery. This unsatisfactory state of affairs is usually brought about by the fact that when new machinery has been purchased, the same labour force has been maintained (probably they have had less physical labour to do) but the production from the farm has not increased to cover the extra charge for capital invested in the machine, running costs and repairs.

I consider that a farmer is justified in buying a machine only if he can see that the annual output of his farm will increase by the amount the machine will cost and *without any extra labour charge*. For example, if the machine is to cost £100, then the yearly output from the farm must increase by £100 and the labour force remain the same. That, I suggest, is mechanization to increase output per person employed. I appreciate that the right ultimate

aim of the use of machinery may well be to make life easier, but I do not expect to see the dawn of that delightful day in my lifetime !

The Proper Use of Farm Machinery I feel that the proper use of farm machinery is threefold : firstly, to increase production per person employed ; secondly, to increase production per acre and, thirdly, to reduce the cost of production. I have dealt with the first at some length, but the second point is perhaps of far greater importance from a national rather than an ordinary farmer's point of view, since rent is a small item in his expenditure (seldom amounting to more than 5 per cent of his outgoings). But as a rough guide I think every farmer should aim at producing at least twenty times the rent of the land, and if he cannot do that he should feel that he is not pulling his weight in feeding the people of the country. When buying a farm a farmer should ask himself : can I get an annual output equal to what I am paying for this farm ? I say this because the farmer, as the landlord, should get 5 per cent interest on his investment ; and so, as tenant, the farmer should consider that as his rent ; thereupon he aims at getting twenty times that rent in output, and so the total output is just equal to the cost price of the farm. That little calculation goes to show to what extent the price of farms has risen in recent years—quite beyond their true economic value to the working farmer. That an output of £100 or more per acre (this being the price that has been paid for farms) can be achieved by a proper balanced system of farming cannot be disputed, but when the average for the whole country is somewhere about £24 per acre, it follows that the standard of farming must be well above average if the persons taking these farms are to make a satisfactory profit.

My third point, to reduce cost of production, is perhaps the hardest of the three to achieve, but it can be done by a balanced system of farming because if you get a proper balance between one kind of stock and another, you make an equal demand on the labour force the whole year round, and so more time is spent on profitable production, and that in turn makes more work for the machinery, and it is by working the machinery the maximum number of hours in the year that the lowest running costs are obtained. A recent survey showed that the running of a tractor 200—400 hours a year cost 5s. 5d. per hour, but when this was stepped up to 1,000 hours the cost fell to 3s. 2d. The same applies to all machinery, and it is for the same reason that farmers who are at all short of capital should buy only the machines that will work the longest hours and hire those which will only work a few hours in the year. Far too much capital is put into machinery today which should be invested in stock. The latter will grow into money, whereas the former has to stand depreciation costs.

These are the broad principles which have governed our farming—through good times and bad. We have been able to see a steady increasing production year by year, and while we cannot now hope to continue to double our production every five years (a target we did obtain for the first twenty years), we can see a steady production on a small farm which, simply by reasonably good farming, we have been able to build up so that it is capable of carrying 50 head of cattle, 2,000 hens (and for most of the year, 3,000 chickens), 40 ewes (and for about six months of the year, their lambs), and 12 sows (with their followers). This stock, together with the land work, provides work for five people, but it is only possible, of course, by the use of a considerable range of machinery. The produce from approximately another 70 acres has to be purchased, but even if the farm were stocked so that it was

entirely self-supporting, it would still carry far more than the average number of animals for its acreage than is the average for the country as a whole; and we can, with reasonable luck, hope to pass to our children a better farm, both in fertility and cultivation, than we took at the start of our farming lives.

LEAD POISONING IN FARM ANIMALS

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Lead was among the first metals used by the early Egyptians and Phoenicians, and some of the toxic effects of its compounds have been known for centuries, but in spite of, or perhaps because of, this familiarity, many farmers and stockmen do not realize the dangers of paint and other lead compounds to livestock.

A FEW years ago investigations were carried out at Weybridge to provide information to help in the diagnosis of cases of suspected lead poisoning in farm stock, especially in young bovines. The results were published in a series of scientific articles, but from the number of cases of lead poisoning confirmed every week at this Laboratory from suspected cases submitted by only a relatively few veterinary surgeons, it is evident that many valuable animals are still dying as a result of taking in lead compounds. Cattle, and especially calves, seem to be particularly susceptible to lead poisoning. This is no doubt due to their licking, sucking and chewing habits. But the deaths of many valuable animals could be prevented if precautions were taken to prevent the animals gaining access to materials containing lead.

It is perhaps not realized that many things commonly found on a farm are often a potential source of danger. Since the best paints, from the point of view of preservation of wood and durability, usually contain lead carbonate, the commonest sources are painted woodwork and metalwork and discarded paint tins and paint scrapings ; other materials which may contain dangerous amounts of lead are old painted tarpaulins and roofing felt, discarded batteries, vegetation in orchards recently sprayed with lead arsenate solution, and putty containing red and white lead. It is not always easy to find the source of lead. In calf pens and cow byres a lead paint is very often covered by whitewash or a bituminous paint, and is thus regarded as perfectly safe ; but a calf can easily chew off the outer covering and lick and swallow enough lead paint to cause death.

It has been found that a relatively small amount of lead can be fatal to a young calf. For example, as little as one-third of an ounce of dry paint scrapings, containing approximately one-sixth of an ounce of lead, was sufficient to kill a week-old calf. But, as would be expected, individual susceptibility to lead poisoning in calves appears to vary, so that no hard and fast toxic limits can be laid down. From information obtained from many cases of lead poisoning in calves submitted to this laboratory, and

from experimental observations of toxic effects of various amounts of different lead compounds, the lethal dose for calves appears to lie between 0.15 and 0.25 grammes of lead per kilogram body weight (approximately $\frac{1}{4}$—$\frac{2}{5}$ oz. per 100 lb. live weight), but older animals are more likely to survive doses of this order. The fatal dose for sheep appears to be higher (about 0.4 grammes of lead per kilogram body weight), while the few observations made on adult goats indicate that they can tolerate even larger amounts than sheep.

Death may be Sudden Very often there are no symptoms until an hour or two before death, and if the animal has not been under observation it may simply be found dead with signs of having had a "fit". A very large dose of lead, such as would be taken if a calf licked wet paint from a tin, may produce symptoms within twenty-four hours, but usually the first signs do not appear until several days after a lethal dose of lead has been taken. Some cases have been known in which there were no symptoms until about two weeks after ingestion of the lead compound. The first indications are usually dullness and loss of appetite, followed by evidence of abdominal pain, constipation, grinding of the teeth, and salivation. Constipation in some cases is followed by diarrhoea. These symptoms do not always occur, and sometimes the first indication is sudden bellowing and staggering, with rolling eyes and frothing mouth. In this phase, which can last up to two hours, the calf is greatly excited, attempts to push against or climb walls, and seems to be blind and unresponsive to any outside stimulus. After collapse, muscular spasms and tetany occur with increasing frequency until death. This series of symptoms represents the common clinical picture in accidental poisoning of the calf, but the phase of excitation has not been observed in sheep given fatal doses of lead compounds.

There may be no visible signs of poisoning at a post-mortem examination. In calves there may sometimes be inflammation of the fourth stomach and the adjoining two or three feet of the intestine, or even for a greater length of the gut, but these lesions are not constant and vary greatly in intensity. It should be stressed that neither symptoms nor post-mortem appearances are specific for lead poisoning ; other disorders may produce the same sequence of events, so that veterinary advice should always be sought. If there is doubt about the cause of death, the veterinary surgeon can confirm or eliminate the possibility of lead poisoning by having the lead content of samples of kidney and liver estimated.

Chronic or Cumulative Lead Poisoning Cumulative lead poisoning is well known in human beings, and can occur as a result of inhalation of lead dust or fumes. But in farm animals lead enters the body most commonly through the mouth, and there is little evidence at present that cumulative lead poisoning occurs to any extent in cattle and sheep. However, it is possible that continuous ingestion of small quantities of lead might result from the flaking of lead paint from food receptacles and stalls, contamination of rations with lead compounds or dust from processing machinery. The possibility of poisoning due to the lodging of lead metal in the digestive tract has been suggested, but investigations at Weybridge have shown that this is extremely unlikely. Thus in one experiment about 1 lb. of lead shot was given to a calf over a period of four months, while another was given about the same amount of fine metallic lead dust. When these calves were killed five months after the first dose, the amount of lead in the liver and kidney indicated that absorption of the

metal had been so small that there was no danger to either calf. Incidentally, 85 per cent of the lead shot was found to be still in the digestive tract of the calf when killed.

Another very commonly suspected cause of lead poisoning in farm stock is contamination of water supplies passing through lead pipes, but although many suspected samples of water have been examined, none has yet been found in which the concentration of lead was high enough to be harmful.

Several long-term experiments were undertaken at Weybridge on cumulative lead poisoning in cattle and sheep. Lead was given in various forms (in solution as the acetate or nitrate, and as the water-insoluble carbonate or sulphide) in increasing amounts over a matter of months or years. In two experiments on cattle, which started when the animals were three-months old and ended when they died after five and a half years, the total amount of lead taken in by each was over 10 lb., given at the rate of $\frac{1}{28}$ oz. (1 gramme) per day for the first year and increasing at intervals to $\frac{1}{2}$ oz. daily in the sixth year. It is of interest that none of the animals that died as a result of long and continued ingestion of small amounts of lead showed the symptoms of extreme excitation or of abdominal pain that were observed in the cases of acute poisoning in calves. There was loss of appetite and constipation followed by recumbency and death without muscular spasms.

The possibility of chronic lead poisoning in sheep and cattle grazing over old lead-mining areas where the pastures may become contaminated by soil high in lead has also been investigated. By estimating the lead content of blood and faeces from such animals it was found that there had been very little absorption of lead, and it is therefore concluded that this source of lead is very unlikely to be a danger to livestock.

Precautions and First-Aid If chronic lead poisoning is suspected in the living animal, veterinary advice should be sought immediately. Possible sources of lead should be looked for and removed, and purgative treatment given to promote elimination. In cases of acute lead poisoning there is no treatment that is likely to be effective, but a purgative is always worth trying. It should perhaps be mentioned that although chemical analysis is of very great value in the diagnosis of lead poisoning, considerable experience is required for interpretation of the figures ; otherwise a misleading conclusion could easily be reached.

Finally, it cannot be too strongly emphasized that calves should not be allowed access to any painted woodwork or metalwork, and that any materials that might contain lead compounds should be disposed of in such a way that no animal can gain access to them. No possible source, however unlikely it may seem, should be overlooked. In one case of lead posioning in a calf, the source of lead was found to be a discarded oil painting which, although apparently unattractive to the owner, had a fatal attraction for the calf !

DOWNS AND DUNES

A recent book by Sir Edward Salisbury, Director of the Royal Botanic Gardens, Kew, and published by Bell at 45s. is reviewed by

A. H. HOARE

A LARGE proportion of English farming land lies on chalk and limestone formations, but it is perhaps the chalk country that holds the greatest interest. Sir Daniel Hall wrote in *A Pilgrimage of British Farming* : " Chalk farming is in many respects the most distinctive of English agriculture. No other geological formation is so widely developed ; from Salisbury Plain to the South Downs and north to the Yorkshire wolds the chalk country possesses a character of its own". Sir Daniel would also have agreed that the chalk country was in many ways the cradle of British agriculture, for it was on the chalk uplands of southern England that the Neolithic peoples made their settlements*, after a period of nomadic existence, kept livestock (the animals browsed as much or even more than they grazed), and began with primitive tools of flint and wood to cultivate the land for crops.

Downs in the Making There is little to be said in support of a view that these uplands of southern England were always open downs, even in early times. Rather, authoritative opinion takes the line that originally they were largely covered with a natural growth of scrubby woodland—mainly oak and hazel. It was man who cleared the woodland growth over the centuries, so that in the end the familiar landscape of open downland was created. It was a passive possession that eventually confronted man, a landscape of ploughland and pasture that took its place in our national life more than two thousand years ago. And then came the era of the sheep, for wool was to become and remain for centuries " the flower and strength and revenue and blood of England " till the development of the cotton trade late in the eighteenth century brought a change. Gradually, the sheep walks, with their close mat-like covering of sweet herbage, have disappeared, but the well laid out farms running up the slopes of the downs are a testimony of the prosperity that attended the development on the chalk of the mixed farming which has become the pride and mainstay of our land.

It would be difficult today to find the shepherd and his dog attending a wandering flock of sheep (so well described by W. H. Hudson in *A Shepherd's Life*), for like the swineherd and cowherd of medieval days, he, too, has gone. But the chalk countryside remains, a unique heritage, for today we still can walk those old downland tracks, the Ichneild Way from Marlborough to Thetford, and always feel close to man's history in these islands. Ancient encampments like Dorset's Maiden Castle interest the archaeologist, and the traces of Celtic field systems on Wiltshire's Fyfield Down the agriculturist. Botanists and entomologists exploring the downlands find them an inexhaustible source of interest. The explorer may come across the remains of grain drying kilns that the Romans used, heating them with hot flints—those flints of the chalk from which the Neoliths fashioned the blades of the first sickles ever used by man.

* The site of a Neolithic settlement (Whitehawk Camp) has been located on that part of the Sussex Downs now occupied by the Brighton racecourse.

DOWNS AND DUNES

In *Downs and Dunes*, Sir Richard Salisbury renews our interest in England's downland country. Although the book is primarily about plant ecology, such is the diversity of subjects dealt with (the ecologist necessarily casts his net widely) that a great many people who are not botanists, and farmers and gardeners particularly, will find it a source of interest. The author showed, in *The Living Garden*, that he is able to present scientific knowledge in simple English, and now again he has made full use of this gift of lucid writing. It is a book that many will wish to stand beside Jacquetta Hawkes's *A Land ;* the one deals with the crust of the world on which we live, the other with some types of its vastly varied vegetation.

I could not resist referring to *A Land* to see again what had been written about the phenomenon of chalk : " Chalk, once believed to have been built entirely from the bodies of minute sea creatures, is now recognized as a chemical precipitate, probably, however, created by the action of living algae and certainly crowded with the minute but elegant forms of the Foraminifera". Certainly that cretaceous sea of a prehistoric age bequeathed man a formation that was to play a great part in his social development, containing as it did the material for his first tools and weapons. Those illustrations of flint tools in Curwen's *The Archaeology of Sussex* or his *Plough and Pasture* will be studied with renewed interest after reading *Downs and Dunes*.

A work on plant ecology helps the farmer, planter and gardener, for it is easier to grow crops successfully when we have some knowledge of the relationship that exists between a plant and its environment, and some idea of the workings of nature in clothing the face of the earth with vegetation. It is the natural vegetation that conveys much of what we want to know about land. There was a time when those who searched for fruit-growing or market-gardening land did not go armed with a soil auger ; they used their eyes only and studied the natural vegetation. Such observations seldom misled. Heaths, moors, downs, wolds, dunes and vales, all have their characteristic vegetation; each tells its own story to the experienced observer.

The Chalkland Habitats How did soil form on what is a remarkably pure kind of limestone ? "Weathering" of such a rock was actually more chemical than physical in action. Leaching of the calcium carbonate on the flat crests of the downs sometimes so changed the *p*H condition on the surface that even acid-loving plants such as heather could flourish. But it is on the slopes of the downs that we find the true flora of the chalk, composed of plants whose deep-rooting facility is stimulated by the calcium ions of the chalk itself. This deep-rooting habit explains the drought-resisting capacity of many plants on the chalk ; the Horseshoe Vetch, for example, was found to have roots over 24 inches deep, and the Chalk Milkwort, a mat herbage plant, roots 11 inches deep.

The result of man's life and activity on the chalk is that he himself became an important biotic factor in the development of what may be termed sub-habitats. By clearing away the woodlands, he eventually created, with the help of grazing animals (mainly sheep), the open downs with their mat-like pasturage of grasses and plants. (At one time as many as 150,000 sheep were pastured on the Sussex Downs alone.) Later, crop cultivation by man resulted in arable fields, so bringing into existence a weed plant association. Another activity, chair-making, led to the extension of beech woods (on the Chilterns particularly), for no useful timber flourished on the chalk so well as the beech. But evidence disproves the old saying : " nothing grows in the shade of the beech". Another sub-habitat of interest

was created when, as a result perhaps of economic depression, the development of chalk scrub was allowed to proceed unchecked. Scrub was of interest alike to the botanist, ecologist and agriculturist, for they saw how nature could extend a reclaiming hand, recolonizing lost territory with Spindle, Juniper, Privet, Wayfaring Tree, Buckthorn, Traveller's Joy, and many herbaceous plants, amongst them the odorous Wild Marjoram.

Downs and Dunes contains descriptions of the different sub-habitats of the chalk, together with biological notes on the species forming each plant community—64 of the chalk downs, 18 of the cornfields, 22 of the beechwood, and 18 of the scrub. Few formations provide such an interesting flora as the chalk, and it may be claimed also that none contains so many rarities ; the springtime Pasque Flower, to mention one only, is a sufficient reminder that the claim is not groundless.

There are chapters in this book dealing with other limestone formations (oölitic and carboniferous), a study of which takes us away from the downs of the south to the Cotswold country of Gloucestershire and the rugged limestone terraces of Derbyshire. In these regions, both climate and soil are important habitat factors, and although the amount of exchangeable bases in the soil is not high, it is interesting to note how closely the vegetation of these limestones resembles that of the chalk. Twenty-seven flowering plants may be described as being characteristic limestone species, among them the Meadow Saffron ; it seems a long time since the pale-purple tube-like flowers of this strangely beautiful plant were seen in a Cotswold meadow ; livestock farmers know the reason for the present-day scarcity of this plant.

The Dunes—Deserts of Northern Latitudes

In contrast to the solid basic formation of a down, a dune is a dynamic uneasy creation, an area of deposited sand which (at least in its early phases) seems forever to be losing as much as it gains. For the onshore wind which brings inland the harvest of sand may, with a shift of direction, move it elsewhere. Yet it is on duneland areas that we can see something of a land in the making—how a few remarkable plants maintain fortification of the foreshore against the encroaching sea. Suffolk has a duneland area at Kessingland which is providing some compensation for the serious loss of land lower down the same coastline at Dunwich.

In their early stages sand dunes form a kind of temperate zone desert, a desert conditioned not by climate but by a physical incapacity of the deposited material to retain water. The challenge of an arid environment is accepted by one of the world's most tenacious colonizing plants, Marram Grass. With or without the company of Sea Wheat Grass, Wild Beetroot, Sea Kale (really a shingle species) and Seaside Woody Nightshade, this plant succeeds in binding the sand together to prevent drifting. At Kessingland, incidentally, the common yellow lupin—*Lupinus arboreus*—can be seen acting as a pioneer colonizer.

Sir Edward Salisbury lists eighteen plants which are pioneer colonizers of the first phase of a dune system—the dune face and drift line. But more and more plants come in during the succeeding phases of the early yellow dune: the later yellow dune, with its characteristic ridge outline of tufted Marram Grass ; the fixed grey dune, so called because of the widespread carpeting by lichens and mosses ; and, lastly, the older dune and dune scrub. The rate of plant establishment is astonishing considering that the environment has to be progressively ameliorated by the plants themselves. In the first

phase of a dune system there is neither water nor soil; only sand and varying amounts of calcium carbonate ; in the final phase there is sufficient soil and water to support a plant community that may include eight trees and twenty-nine shrubs. Altogether the British dune flora includes some four hundred species of vascular plants, besides a number of mosses, lichens and liverworts. Some one hundred and forty-five of the flowering plants occur on fixed dunes, compared with only twenty-six species on the dune face and early yellow dune taken together. But what is particularly interesting in the story of the dunes is the fact that nature both imposes and exacts compliance with her own terms. "The pioneer specialists that render the habitat suitable for their successors bring about their own extinction, and the final outcome makes possible the establishment of a community of an entirely different character." It is with these words that Sir Edward Salisbury closes his account of the dune systems in Britain.

The book, the author explains, had its origin in the two courses of lectures he delivered as Fullerton Professor of the Royal Institution. As easy as the text is to understand, it is made even plainer by means of a hundred maps and line drawings. It is helped also by thirty-two plates from photographs taken by the author ; these include several views of different kinds of dune, with typical vegetation, illustrating clearly the remarkable nature of each phase of sand dune development.

Books recommended for supplementary reading

The Golden Fleece. G. W. Morris and L. S. Wood. Oxford University Press, 1922.
The Archaeology of Sussex. E. C. Curwen. Methuen, 1937.
Plough and Pasture. E. C. Curwen. Cobbett, 1946.
A Land. Jacquetta Hawkes. Cressett, 1952.

VISIT TO MALTA

A. A. Eastwood
National Agricultural Advisory Service, South-Eastern Province

Mr. Eastwood, the Poultry Advisory Officer in Buckinghamshire, visited Malta and Gozo a year ago to see some of the private and Government farms and to lecture on poultry-keeping. Below, he records some of his impressions of the livestock industry of the islands.

THE casual visitor to Malta is liable to get the impression that, apart from draught animals, and the small herds of goats and sheep which graze on the roadside, the island is devoid of livestock. On closer inspection, however, he will soon realize, as I did, that hidden away behind the high limestone walls of the farmyards are some excellent Friesian cows, Large White pigs and, on most farms, a heterogeneous flock of poultry. The latter are kept mainly as scavengers, but they also provide an additional source of income.

The high quality of the pure-bred stock, which, in many cases is as good as any to be found in England, is due mainly to the post-war policy of stock improvement initiated by The Hon. B. Camilleri, Minister of Industry and

Commerce, subsequently supported by The Hon. C. Caruana, Minister for Posts and Agriculture, and put into effect by Mr. R. Biasini, Director of Agriculture, with the co-operation of the island's Principal Government Veterinary Surgeon, Dr. Casser, and the Superintendent of the Government Farm, Mr. S. Zammit. This farm of 46 acres, at Ghammieri on the outskirts of Valletta, has made an important contribution to the economy of the island, not only by introducing new breeds of stock and demonstrating their capabilities, but by serving as a centre for the maintenance and distribution of a nucleus of the selected breeds. The distribution takes place at an annual sale which is attended by keenly competitive farmers from both Malta and the neighbouring island of Gozo.

Cattle During the past few years, a number of different breeds of cattle including Ayrshires, British Friesians, Shorthorns and Dutch Friesians, have been imported, but because of their heavy milking qualities, as compared with the other breeds, the Friesians have proved to be the most popular. In consequence, recent importations of Friesian in-calf heifers and cows have been eagerly bought by the farmers, and although no further importations have been made in recent months, because of outbreaks of foot-and-mouth disease in Europe, many people think that, by 1958, the milking herds may be entirely of Friesian stock. The predominance of the Friesian is being accentuated by the hire and sale of young Friesian bulls to the local bull-keepers, who often keep from two to three bulls for service. These bull-keepers must be licensed and their animals are liable to health inspection, although no stipulation is made that bulls should be pure bred.

But this method of stock improvement, i.e., through the male, is weakened by the practice favoured by the farmer of keeping his bull for only a short time. While in Malta servicing takes place all the year round, the demand for servicing in Gozo is confined to three months—September, October and, at the very latest, November—and it is customary to use a bull at ten to twelve months for heifers, and then gradually to fatten it for disposal at eighteen to twenty-four months. Thus in the normal course of events a bull is available only for one short season, while, during the fattening period, the bull-keeper is busy raising the herd of bull calves for the following season. One enterprising bull-keeper I saw was actually training a bull to pull a plough in order to keep it actively employed during the slack period.

Apart from the older bulls and cows cast from the dairy herds, beef cattle are imported as growing bulls from North Africa in batches of eighty to a hundred. After isolation as a precautionary measure, they are sold to farmers, and after three to four months' intensive fattening they are sent for slaughter.

Pigs, Sheep and Goats Without exception, the breed of pigs kept is the Large White ; an example of how the Government's policy of importing, multiplying and then distributing one particular breed has led to the complete elimination of other breeds. Attempts to improve the native breed of sheep have met with only partial success. East Friesian sheep were imported and crossed with them, and although some flock-owners have used the first cross, the majority of farmers still prefer the native breed, since its milking qualities are superior to those of the imported breed. This milk is used for the production of an excellent small, round, soft cheese, called "gbejna". The sheep are kept in very small numbers, varying from one to ten, and therefore few owners keep a ram with the flock. The ram-keeper travels his ram through the villages during the breeding season.

The population of goats still exceeds that of all other animals on the islands, but while herds of fifty to a hundred can be encountered grazing the so-called "English Weed"* on the roadsides, as milk producers they are gradually losing ground to cows. Imported British Saanen males, when crossed with the Maltese goat, have led to some improvements in body size. They have the merit, too, that their short hair makes udder clipping unnecessary. The British Saanens appear, however, to have some difficulty in adapting themselves to their changed environment, so that, while an infusion of Saanen blood might be beneficial, it is doubtful whether, as a pure breed, they can ever compete with the hardy island goats.

Poultry The only large farm which is devoted entirely to poultry is that run by the Maltese Government at Wied Incita where, in keeping with the policy of distributing selected pure breeds among farmers and smallholders, a model farm, comparable with many of its counterparts in England, has been established. The farm layout, with concrete houses for easy cleaning and disinfection, ample grass runs, and trees provided for shade during the excessive heat of summer when the grass is likely to become bare and brown, provides accommodation for 5,000 head of poultry and growing stock.

Only two breeds—Rhode Island Reds and Maltese Blacks—are kept at the farm. The latter appears to be better adapted to the environment and thus more suited for distribution among the farming community. It is a medium breed, resembling a small Minorca, active, hardy and quick to develop. It lays a 2–2¼ oz. egg, and seems ideally suited to the Maltese summer.

Fight Against Fowl Pest Fowl pest has considerably retarded progress in the distribution of improved strains of poultry. First recorded in Malta in 1945, it has frequently decimated the poultry on the island and, in outbreaks which occurred during the latter months of 1951 it is estimated that 55 per cent of the laying flocks were involved. This was reflected in the price of eggs, which reached as much as 9s. per dozen in January 1952. In contrast with our practice, notification of fowl pest on a holding is not compulsory, and no compensation is paid for slaughter. Disposal of intected carcasses is left to the farmer, and they usually find their way to the manure heap !

In an attempt to control outbreaks of fowl pest, the Government has introduced a live vaccine, *Mukteswar*, which originated in India but was imported from Palestine. Its effects were drastic. The vaccinated flocks showed symptoms similar to those of a natural outbreak, with typical paralysis of the legs and neck, and greenish-yellow diarrhoea ; mortality varied from 4½ to 10 per cent. The vaccine is said to give lasting immunity and its initial cost is low (1s. per 500 birds), but in view of the loss of production and high rate of mortality caused by its use, a search was made for an alternative. As a result, a Swiss vaccine, *Avipest Berna*, has been tried and appears to cause little reaction on the part of the vaccinated birds. Mortality was nil at the time of my visit and egg production remained normal. Its disadvantages, however, are that it costs 5d. per dose, and immunity lasts only three months.

* Cape Sorrel (*Oxalis cernua*). It derives its common name from the fact that it was originally brought into the Island by an English visitor. It is now a major weed of arable land in Malta.

Experiments to ascertain the value of the vaccines against fowl pest have proved inconclusive. Two groups of ten pullets treated with these vaccines, together with five (non-vaccinated) controls, were placed on holdings where the occupants had recently died from fowl pest : the result was a complete failure to reproduce the outbreak.

Although my visit was brief, I came away with the impression that many of the problems I discussed with Maltese farmers were the same as those familiar to farmers in this country ; and that if the keenness and efficiency among the officers of the Maltese Ministry of Agriculture is any criterion, the next few years should see continued progress in the island's agriculture.

WALTER OF HENLEY AND THE OLD FARMING

NIGEL HARVEY, M.A., Q.A.L.A.S.

Apart from occasional quotations in historical literature, the life and work of Walter of Henley—often, but incorrectly, described as the first of the English farming writers—is still shrouded in obscurity. Yet an examination of his writings illuminates some of the difficulties and problems of management facing farmers in the thirteenth century.

THERE are, in principle, three ways of increasing agricultural production. You can cultivate more land, you can use improved tools, or you can make better use of existing resources. The first was the way of our forefathers who, generation by generation, hewed their farms from the primeval waste which they eventually destroyed. The second is a relatively modern phenomenon—a by-product of the industrial and scientific progress which has produced the internal combustion engine and atmospheric nitrogen. But, unfortunately, the spectacular achievements of reclamation and technical development too often obscure the routine importance of the third factor—the more domestic virtues on which farm production depends. Yet good management has always been one of the essentials of good farming and, significantly, it was the need for good management which, seven hundred years ago, inspired the first agricultural literature in our history.

Even in those days, it is true, the professional manager of farmland was no new figure. In medieval times the great lords of Church and State took little personal interest in farming—the old coats-of-arms, for instance, seldom contained agricultural symbols—and they relied for the administration of their estates on a minor civil service of seneschals and bailiffs, clerks and accountants. But the thirteenth century brought new incentives to this established system, for the development of trade was creating, in the midst of an essentially rural society, cities and seaports with populations divorced from the productive soil. Now, these new markets meant prospects of new profits. But they also meant new problems, sometimes of administration, sometimes of policy. In particular, there was this question of taking lands in hand and cultivating them as demesne-farms, instead of leasing them to tenants. And it was these changes which provoked a sudden outburst of agricultural literature to assist the puzzled landlord.

WALTER OF HENLEY AND THE OLD FARMING

Between 1200 and 1300 there appeared, without precedent and without immediate successors, four treatises on the management of farms and estates, differing in style and emphasis, but similar in basic character. All were written by educated men : all were written for educated men—for the commercially-minded landlord who lived on his rents and the profits of his lands-in-hand, for the employer of a large and varied staff, for the lord to whom accounts and records were presented at the end of the year. All were highly practical and applied : all were written not in scholarly Latin but in Norman-French, the language of law and secular literature. They were, in fact, manuals for landlords—the medieval equivalent of a text-book on the management of landed property. Three of these treatises dealt mainly with the administration of estates, and were concerned with the office and the household rather than the farm. The fourth was more directly agricultural, and in it Walter of Henley addressed the landowner who was farming his own land.

Treatise for Landowners Very little is known of the personal life of this Walter. Even his birthplace is obscure, for there is more than one Henley in England. He is, however, described as a knight, so he probably came from the class of lesser gentry—the ancestors of the squires who were later to play so dominant a part in rural affairs. In later life he became a Dominican, one of the Order of Preaching Friars who first came to this country in 1221. This, incidentally, helps to establish his dates, for the first extant manuscript of his work was written about the year 1300. Clearly, therefore, he flourished somewhere in the middle or latter half of the century, contemporary with, say, Simon de Montfort or Edward I. It also explains his vivid, intimate style with its constant proverbs and interjected questions, ; he had learnt the tricks of the teacher's trade as a wandering preacher who addressed casual crowds in the market-places or on village greens, as well as more formal congregations from the pulpit. And it was probably as a churchman that he became bailiff of a group of ecclesiastical manors, where he must have accumulated much of the experience he summarized in his book.

It is clear, therefore, that the convenient description of Walter of Henley as " the first of the English farming writers " is something less than a half-truth. In particular, he was not *the* first, he was merely one of the first four, and he did not write in English. Moreover, this phrase " farming writer " needs some analysis. Walter was certainly writing about farming, but the members of his audience were not primarily farmers ; they were landowners who, perhaps for the first time, were farming their own lands through bailiffs, and their hands were accustomed to the medieval equivalent of the shooting-stick rather than the hoe or the hay-rake. His book, therefore, is in no sense a manual of practical agriculture. It does not, for instance, tell the reader how to plough, sow or reap. Rather is it a manual of farm management which tells him in what manner he should organize, and by what standards he should judge the men who do the ploughing, reaping and sowing. There is no attempt to provide a systematic treatise on the farming routine and practice of his day. Walter assumes that these are familiar to all his readers, and he contents himself with a commentary of hints and advice on them. Much of what he says is, in consequence, the normal common sense of farm and estate, and it is his implications, his omissions and his emphasis which give the book its peculiar historical interest.

He begins with a fairly obvious piece of advice. First of all, he says, the landlord should prepare a register of his property, listing the physical

resources of his estate, the acreage of ploughland, pasture and forest, the number of ploughs, stock and dove-cotes. This register should also detail the various rents and services owed by the tenants, for on the former, which were commonly paid in kind, depended the maintenance of the lord's household, and on the latter, the labour force of the Home Farm. This minor Domesday Book was, indeed, the basic document of the estate, and its contents illustrate strikingly the farming conditions of the time. It is preoccupied, for instance, with land and labour, for these were the two primary factors in the economy of the Old Farming. Capital equipment, as we know it today, came much later when the farmer, having exhausted the redeemable waste, was compelled to intensify his methods instead of increasing his acreage. Thus drainage is proverbially "the first of improvements", but Walter refers only to the ridging of wet lands into the familiar hump-backs which still pattern so many of our fields in the clay areas. Stones and bushes lay around for the taking, but, as yet, no man thought of deep drainage. Agricultural necessity was the mother of reclamation before she became the mother of invention.

Shortage of Fresh Meat in Winter Even more significant is the prominence given in this survey to dove-cotes. Today these are no more than a picturesque luxury—the home of feathered pets. But in former times they were the sole source of fresh meat for several months in the year. In the days before the root crops were introduced, hay was the only known winter fodder for cattle, and the amount and quality of this hay was pitifully limited by circumstances beyond the control of our ancestors. For one thing, they were entirely dependent on whatever sward nature chose to provide in the locality ; for another, they cut and made it by hand labour, so that they must have suffered heavy losses in bad seasons. Yet the supply of hay controlled the number of cattle which could be carried through the winter. In consequence, surplus cattle were killed and salted down every autumn, so that our forefathers were compelled to live for much of the year on preserved meat. Hence the craving for spices which drove the old adventurers first to the Middle East, then to the Indies in their search for flavourings to relieve the monotony of their winter diet. As the result of this policy, only a depleted herd survived the winter, and even then in wretched condition, "waxing faint and looking poorly and thin". Yet upon such stock depended manure and power for the ploughlands.

Here, then, was the limiting factor in the Old Farming—the impassable barrier to increased food production and, consequently, to the development of material civilization itself. Indeed, this "hungry gap" between hay and new grass haunted the lives and literature of our forefathers, and Walter's advice to begin buying cattle at Easter "when they are cheap" echoes the craving for spring which inspired so many of the old songs and ballads ; the background here is no mere romantic fancy for bird songs and leafy boughs, but bitter economic need. When, for example, in far-away Italy the greatest of Walter's contemporaries sought in his dream of deepest hell for a metaphor of fear and despair, he pictured a farmer whose store of hay had failed before the coming of the spring grass as :

. . . he paced to and fro, wailing his lot,
Like a discomforted and hopeless man.

Dante was no farmer but he knew, as did all the men of his time and for centuries later, that when the warm weather and the new flush of grass tarried cattle died and men went hungry.

Emphasis on Corn It is, therefore, with corn, the direct source of food, that Walter is mainly concerned, but the advice he gives soon makes it clear that he is addressing the organizer rather than the working farmer. He says little about practice, much about principles and policy. He recommends the early sowing of winter corn, " so that the ground may be settled and the corn rooted before great cold ", but gives no detailed advice on methods of ploughing and cultivation. It is, however, obvious from his words that, at that time, the plough was the primary means of preparing the seedbed. Thus in an attempt to cost wheat growing he recommends three ploughings, but the only other form of cultivation mentioned is a single harrowing, and that, apparently, to settle the seed after sowing rather than to raise a tilth before it. It was with the plough, too, that weeds were controlled on the bare fallow of the open field rotation. The first ploughing of the fallow, said Walter, should take place in April, the second after St. John's Day (June 10, O.S.) " when the dust rises behind the plough, for if you clean the land before that date, the weeds will have sufficient time to grow again ". But, he adds, with true text-book caution : " those who have much to do cannot be expected to do everything at the right time".

Incidentally, it is in this chapter on corn growing that we meet an early form of an ancient tradition which endures to this day. For, says Walter, the wise farmer will change his wheat seed every year at Michaelmas, because—

> seed grown on other ground will bring more profit than that which has been sold on your own—will you see this ? Plough two lands at the same time and sow one with seed which is your own and one with seed which you have bought. In August you will see that I speak truly.

Later and more exact experiments have failed to show any measurable benefit from such a change of seed, but the practice is too old and widespread to be dismissed as mere legend, and W.S. Mansfield, who discusses it at length in his enchanting *The Farmer's Friend*, suggests that the clue to its origin is seed-borne bunt.

> It was the curse of our forefathers who did not know how to control it. Hence, frequent change of seed may have been necessary. Today we know how to control it, and all worthy farmers, before sowing their seed wheat, dress it with either formalin, copper sulphate or one of the newer mercurial seed-dressings. If this was the reason for changing seed wheat, the reason has disappeared. But the tradition still persists.

Importance of Manure After dealing with the plough, punctuality and precautions, Walter turns to the fourth great factor in the raising of crops—manure. On this he has much to say, for in his time muck was limited in quantity and poor in quality. Beasts were few, and the fields received only the residues of their own crops, reinforced, perhaps, by hay from the uncultivated waste, for no purchased fertilizer or fodder came to the farm. Thus one sign of the times was the practice of wintering sheep on straw in the farmstead, for even this most open-air of all farm animals was required to make its contribution to the dung-heap.

Another sign was the strictness of Walter's rules on the management of manure. No straw should be sold off the estate. Some, he suggested, would, of course, be needed for thatching, but all the rest should go for manure. Ditch scourings would eke out the supply of dung, whilst a layer of earth would help to conserve the richness of the middle. Nothing should be wasted, neither should the farmer neglect the more enduring marl.

" Know for certain ", he concludes, " that marl lasts longer than manure ", and the remark illustrates the character of his readers as well as the practice of his times.

On Stock Management Only after ploughland farming had been described in detail does Walter turn his attention to stock, and here his opening remarks reflect once again the nature of the audience he is addressing. " It is well to know how one ought to keep cattle, to teach your people, for when they see that you understand it they will take more pains to do well ". He continues, however, in more technical fashion with a series of hints on management. Cattle, he says, should be rubbed down with straw, as this will encourage them to lick themselves ; calves should suck their mothers for a month before being weaned at the rate of a teat a week, and their need of water should not be overlooked ; whilst lambs should never be allowed to suck wool or they will die with balls of it in their stomachs. More generally, Walter advised regular culling and inspection, with particular attention to the flock in autumn. " On the Feast of St. Simon and St. Jude (October 17, O.S.) kill two good, two middling sheep and two bad sheep " and sell or not according to their condition. The reason for this advice is clear ; he himself makes no direct mention of fluke, but one of his anonymous contemporaries refers to sheep eating " the web of the rime and the little white snails from which they will sicken and die ". Indeed, the losses from this cause on the undrained grazings of Old England must have been fearful in wet seasons. Hence, no doubt, the practice, vigorously condemned by Walter, of feeding the mutton of diseased sheep to labourers. It does happen on some estates, he admits, but " I would not have you do this ".

More interesting to the historical student, however, are Walter's remarks on the management of pigs, which were still allies rather than subjects of the farming kingdom. For the pig, unlike the grass-eating beasts, could support itself during the winter months by foraging in the woods and scrubland of the waste, where it lived cheerfully on an assorted diet of beech-mast, acorns, leaves, grubs and carrion. When Walter ranked the ability to dig high among the points of the good pig, therefore, he merely echoed the soundly agricultural decision of the Domesday Book commissioners two centuries previously to assess the value of woodlands in terms of the head of swine they could support. Thus the pig stood rather outside the medieval farming system, and it played little part in the cultivation of the ploughlands to which the ox and sheep contributed power or manure. Indeed, one of Walter's contemporaries advised his readers against any attempt to keep pigs as normal farm animals. Little pigs, he agreed, might need protection in hard winters, but if you bring adult pigs on to the farm, you will find that the cost of feeding them, attending to them and making good the damage they do, far outweighs their market value. Man's control of the pig was, in fact, more pastoral than agricultural, and the horse which the swineherd needed to collect his half wild, leggy, razor-backed charges recalled a stage in human development before the coming of the plough.

Difficulty of Selective Breeding Even more striking to modern eyes, however, is Walter's omission of any reference to the various breeds which figure so largely in the modern text-book. But here again we see the crippling consequences of the lack of winter keep for farm animals ; the numbers were too small, and the generations were cut off too quickly to allow selective breeding. Only in the eighteenth

century did the root crops deliver the farmer from this bondage. Only then did stock and stock-breeders come into their own. Bakewell the Breeder was the technical heir of Townshend the Turnip-grower, and with him came Hodge the Hedger who divided the old communal grazings into small enclosures so that controlled mating was possible. But our medieval forefathers knew little of the improvement or the specialization of breeds, and were content with the traditional general-purpose beasts of their area, the cattle producing power, meat and milk, the sheep, milk, meat and wool. Walter would have seen little strange in the reply of the old Cumberland shepherd to criticisms of his flock : " Lor', sir, they are sik as God set upon the ground, we never changes any ".

Horse versus Ox So far Walter has shown himself a sound and reasonable guide to the rural realities of his time. But he is curiously disappointing when he comes to the question of the ox versus the horse as a plough beast, for in a bald little chapter he does little more than point out that the ox is stronger than the horse, cheaper to buy, cheaper to maintain and more valuable when dead. This, of course, is all very true, but it gives less than half of the technical picture ; it does not even mention the crux of the whole argument, namely, the relative speeds of the two animals. Surely, in a less superficial analysis, the horse is a more specialized organic tool than the ox, and its supreme asset—speed of working—is purchased at a considerable cost in general utility. It is, in short, a quicker, not a cheaper, form of plough haulage. The point is remote but important, for it must be remembered that in Walter's time the horse was still a *relative* newcomer to the fields of the English farmer. It was not until some time in the Dark Ages that an efficient type of collar was devised to harness his literal horse-power for agricultural purposes, and though there is some evidence that this was introduced to the West between the fifth and eighth centuries, the first known European picture of a horse so harnessed dates from the tenth century. Yet the place in the farming economy it had won for itself by Walter's time suggests that the men of the Old Farming were prepared to sacrifice the various useful by-products of the ox in order to obtain a more efficient form of mobile power. They were, in fact, going through the same mental processes as the farmers of our time who have gradually abandoned the horse for the tractor ; they paid more but they got a better tool for their particular job. Increased speed meant increased ability to beat the weather, and it is astonishing that a commercial farm manager like Walter should have so missed the point of what must have been one of the standard agricultural arguments of his age. The lapse is remarkable and it is interesting to speculate on its cause. Was Walter giving the general opinion of his time ? Or was he, perhaps, biased by limited or unfortunate experience, or even by personal prejudice ? We have no evidence either way and one guess is as good as another.

Scope for the Agricultural Detective There are, indeed, many other obscurities on which it is equally interesting to speculate. Most of them, of course, will never be solved, because we are dealing with a dead man who can only answer questions through his writing, but some may yield to a patient study of the text he has left us. Consider, for instance, the few clues he has given us on this basic question of his professional stamping-grounds. Thus he refers neither to reclamation nor to the sort of precautions a farmer should take against hard and snow-bound winters. Presumably, therefore, he lived in a settled area of mild climate. Then again, he assumes that chalk is not too difficult to obtain, he makes no mention of

ditches, he apparently regarded fluke as a danger rather than a normal affliction and, unlike one of his contemporaries, did not connect it with snails. All this, surely, argues an area of predominantly medium or lightish land with good natural drainage. Of course, this is little more than guesswork, though the general conclusion is supported by the provenance of the six known manuscripts of his work, all of which came originally from colleges or monasteries in south-east England. Possibly, therefore, the obvious Henley—Henley-on-Thames—is not such a bad clue after all. Not least of the attractions of Walter's book is the scope it allows for agricultural detective work.

It is unfortunate that the observations of so interesting an author exist today mainly as scattered quotations in the standard history books. The only edition of his work was published by Lamond in 1890 and is now scarce and difficult to obtain. Indeed, a detailed and critical modern edition of Walter and his three companions of the thirteenth century takes a prominent place in that imaginary library of agricultural history which so haunts the student of this singularly neglected subject.

FARMING AFFAIRS

Look to the Quality of your Cereal Seed

" Change seed-wheat ever ; barley never " is an old saying, and it may have arisen through the normal custom of growing the barley crop mainly in the low rainfall areas. Nowadays practical trials with wheat, barley and oats show that there is no need to change to seed from another area, provided the home-grown stock is maintained at a high level of purity, and that germination is satisfactory.

Many samples of Atle wheat and other spring cereals are spoilt as seed because they are stored with more than 14 per cent of moisture ; where there is doubt it is always advisable to send a sample to the Official Seed Testing Station, Huntingdon Road, Cambridge, for testing. The speed at which a sample germinates is a good guide to its value ; those that grow most rapidly in the test usually give the best plant in the field.

In all areas farmers are finding that it pays to dress cereal seed with one of the well-known mercurial dressings because this prevents outbreaks of Bunt, Oat Smut and Leaf Stripe.

Autumn varieties of wheat and barley should not be chosen for sowing after January, because they require cool conditions for some weeks after drilling if they are to produce ears in the same season. Winter oats, on the other hand, can be sown as late as March without this risk of failure, but they are unlikely to give such good yields under these conditions as the spring types—like Star, Eagle, Sun II and Blenda. Cereals benefit greatly by early sowing once the soil is fit.

Some of the new varieties are better than the old but it pays to obtain reliable advice before a new kind is bought because more than half of those which come on the market, usually at rather high prices, are withdrawn after a few years.

In choosing wheat or oats for fertile soils, the best results come from a high yielding type with a good stiff straw. Then an increased crop can be obtained by dressing with nitrogen.

Apart from the maximum yielding capacity of a new variety, it is wise to inquire how it stands in relation to important diseases. For instance, Nord Desprez, which has given some of the highest yields in many areas, is liable to drop in yield on rich fenland soils because of attacks of Yellow Rust. Hybrid 46 and the longer straw type Bersée are highly resistant to Yellow Rust and give more regular yields in areas where this disease is likely to be serious.

With barley and wheat, the quality of the resulting crop depends a good deal on the seed that is sown, and unless the variety is correctly named and reasonably pure it is not likely to prove suitable for malting.

Seed cannot be properly judged simply as samples in the corn market. It needs to be carefully examined while the parent seed crop is still growing. Then, diseases such as Loose Smut can be seen, and if other varieties or harmful weeds are present in the stocks they can be recognized. Consequently, the most reliable kind of home-grown cereal seed is that known as " Field Approved".

Good seeds offer the farmer-grower the best chance of obtaining better crops for little or no extra outlay and it is by closely studying their behaviour, and finding what manures and other treatment suits them best, that we can hope to obtain the extra food our country so urgently needs.

F. R. Horne

Farming Cameo : 26. North Westmorland

The county of Westmorland is divided roughly into two districts by a spur of the Pennines running north-westerly from Kirkby Lonsdale via Tebay, Shap Fells, and High Street to the head of Ullswater, where contact is made with Cumberland. This note deals with the area lying to the north-east of this line, embracing the whole of the upper part of the Eden Valley, part of the Lune Valley and the small, subsidiary valleys of the rivers Lowther, Eamont, and Lyvennet. The district stretches for miles from the skyline of the Pennines eastward to the River Tees in an area of heather and peat moorlands, the greater part of which is now a nature preserve. The hill farmers on the east fellsides run their hill-going sheep—Swaledales mainly—on this isolated moorland. With the opening-up of the Pennine Way, many walkers are discovering the charm of this wide, windswept area of moorland.

The rainfall in this hilly country is heavy and fairly evenly distributed, with a heavier fall during the winter months. In the Eden Valley the average rainfall is around 35 inches, but in the high-lying areas it may amount to 55–60 inches or so. Between December and early March the fells are covered with snow to a varying degree, and it is not unusual for the deep drifts to resist the power of the sun until well into June. The winters are invigorating, but are sufficiently severe to require the housing of cattle. Summer temperatures are moderate, and, with the frequent periods of broken weather, conditions are ideal for the continuous growth of grass and crops. Herein lies the explanation for the greenness of our pastures at times when much of the rest of England is burnt up.

Soils vary greatly in the district. Thus, while the Eden Valley is sandy to medium loam overlying the Trias and Permian Sandstones, the western slopes are medium to heavy clay loams, glacial in origin and containing many granite boulders brought down by ice from the neighbourhood of the present granite quarries at Shap Fell. Along the eastern Pennines and across the southern end of the district runs a limestone area which outcrops

in places in great "scars". Here, soils vary in depth, but generally are easily worked ; they carry sweet, short herbage on which all stock thrives.

Owing to the wetness of the climate, and the altitude—the Pennines in the east top 2,000 feet and elsewhere much of the area lies at 1,000 feet and over—there are considerable areas of open fell and enclosed moorland known locally as "allotments". In fact, land of this nature accounts for slightly more than half the district. Here, throughout the year, run the heafed hill sheep. They are brought down to the inland areas during stormy weather and for brief periods for dipping, shearing, tupping and lambing. Stock-rearing in all its phases is the main activity throughout the district, and, almost without exception, farms carry a self-maintained herd of cattle. It is largely because of this that such rapid progress towards complete attestation (over 80 per cent of the herds are now T.T.) has been possible.

In addition to rearing and fattening cross-bred lambs, the valley farms produce milk for wholesale distribution. The cows are carried round one or two extra lactations before being sold as newly-calved third- or fourth-calvers to replenish the dairy herds of industrial Lancashire, the West Riding of Yorkshire, and elsewhere. As one moves towards the farms on the marginal land, there is less emphasis on milk production and more on the production of dairy replacement cattle and store lambs. Further still up the hillside, only the small quantities of milk surplus to rearing requirements are sold. On these hill farms more attention is given to sheep farming, the greater part of the farm income being derived from the sale of draft ewes, wether lambs of the pure hill-going flocks, and cross-bred lambs of the "grey-face" type, that is, Swaledale or Rough Fell ewe × Wensleydale, Teeswater or Border Leicester ram.

The dual-purpose Shorthorn is the predominant breed of cattle and, latterly, breeders have aimed at a lighter beast bred along dairy lines. Many fine herds are to be found in the neighbourhood of Appleby, Kirkby Stephen and the upper Lune Valley. Elsewhere, particularly where milk is of primary importance, herds of British Friesians and Ayrshires are to be found. Westmorland farmers are a cattle-proud people, as may be seen at the many local one-day shows, where competition in all classes is very keen and the highest standard is required to secure a prize.

On the lighter soils of the Eden Valley, where the farms are large, one finds a larger proportion of arable cropping. Oats form the main cereal crop with swedes as the principal root crop, and although some potatoes and barley are grown for sale, most of the crops are intended for fodder ; it is not considered good farming to sell hay, oat straw or roots. A fairly close adherence to the four-course rotation (varied mainly by using a longer ley) enables the regular cleaning of the land. Without exception, swedes, turnips and mangolds are grown on the ridges. As one moves away from the arable area, the same style of cropping persists, but on a reduced scale, and there is a much larger area under permanent grass. Thus, in the provision of winter keep the emphasis passes from oats to hay. It is generally agreed that the standard of arable farming is high, yielding heavy crops, but the uncertain weather can make harvest extremely difficult. Although the same high standard applies to the temporary leys, the obvious neglect of the permanent grass, more particularly of the old pastures, is one aspect on which the farming in North Westmorland can be criticized. However, there is a growing awareness among the more progressive farmers of the potential productiveness of grassland when adequately limed and fertilized. The

scarcity and high cost of purchased feedingstuffs have driven home this fact. More and better grass is being grown, and it is now being used and preserved more skilfully as good quality hay and silage.

Holdings average about 85 acres and, because of this, they are essentially family enterprises. Where labour is employed, it is usually housed in the farmhouse along with the farmer and his family. Very few farmers, even on the larger farms, have cottages for their workers. Lucky is the farmer who has sufficient cottage accommodation to house all his labour ! The former glories of the countryside fairs have disappeared ; this is regrettable in some ways, but one must accept the fact that the revolution which has taken place in our farming demands modern methods of marketing. In this respect, the neighbourhood is extremely well served ; there are a number of well-managed auction marts where weekly sales cater for the freshly-calved cows, fat cattle and sheep. At these centres, at regular intervals, there are special sales of in-calf and store cattle, and fairs at which sheep change hands in very large numbers.

North Westmorland is almost entirely agricultural ; the few industries are small and are directly related to agricultural needs. The atmosphere is free from industrial pollution and, as nature has endowed the district so bountifully, it is not surprising that so many visitors enjoy their holidays in our midst.

R. R. Sinton,
Assistant County Agricultural Officer

World Reporting Service on Plant Diseases and Pests

At the end of 1951 some thirty countries, including the United Kingdom, signed a new International Plant Protection Convention sponsored by the Food and Agriculture Organization of the United Nations (F.A.O.). This Convention is a broad and flexible agreement intended to inspire international co-operation in controlling diseases and pests of plants and plant products, and to hinder or prevent their spread from one country to another with planting material. One method of helping towards this end is to ensure that each country is kept well informed about the occurrence and distribution of diseases and pests in neighbouring countries and other parts of the world. The Convention therefore provided, among other things, for the establishment of a World Reporting Service on Plant Diseases and Pests, charged with the collection and dissemination of such information.

This objective has now been carried a stage further by the issue from F.A.O. headquarters in Rome of a new monthly publication called the F.A.O. *Plant Protection Bulletin*. The primary purpose of the bulletin is to provide a medium for the prompt publication of information about the occurrence of plant diseases and pests of immediate or potential danger, and about their spread to hitherto uninfested areas. It is also intended to report on unusual infestations of plant products, to include information about efficient plant protection control methods and materials, and to describe major control operations which may be carried out on a national scale or through international co-operation. From time to time there will be authoritative reviews of the occurrence and significance of diseases and pests in a specific region or related to a specific crop. Timely announcements will also be made about quarantine and other restrictions placed on plant movement by one country or another.

The scope of the bulletin can perhaps best be judged from a selection of the articles contained in the first two numbers, which appeared in October

and November 1952. In these one can read about such widely different topics as the menace of San José Scale in Western Europe, the locust problem in the New World, the activities of the desert locust in the Old World, the problems of pineapple growers in Mexico, the recent and more or less catastropic invasion of Chile by Potato Blight, the insect pests of Nicaragua, and the progress of plant protection organization in India.

The bulletin costs 30s. a year, or 2s. 6d. for single issues, and can be obtained from the Documents Sales Service, F.A.O., Viale delle Terme di Caracalla, Rome, Italy, or from H.M. Stationery Office, P.O. Box 569, London, S.E.1.

Suggested Grass Seed Mixtures The National Agricultural Advisory Service, in consultation with the Seed Production Committee of the National Institute of Agricultural Botany, the Grassland Research Station, the Seed Trade and the National Farmers' Union, suggests the following grass seed mixtures for sowing in 1953. The recommended total seed rates are given as a guide but can be varied to suit local conditions. In case of a shortage of any species or strain, farmers and merchants should seek advice about modifications.

Certified seeds of bred strains are strongly recommended for the mixtures in which they are specified.

1. ONE-YEAR LEY

For Hay and Aftermath Grazing

	lb. per acre
Italian ryegrass	6
Perennial ryegrass	6
English broad red clover	4
Late-flowering red clover	2
	18

2. ONE- OR TWO-YEAR LEYS

For Hay

	lb. per acre
Timothy	8
Late-flowering red clover	5
White clover (S.100 or certified New Zealand)	1
	14

For Silage and Aftermath Grazing

	lb. per acre
Timothy, certified S.51	4
Meadow fescue	7
Late-flowering red clover	4
White clover (S.100 or certified New Zealand)	1
	16

3. SHORT-DURATION LEYS

Two to Three Years

	lb. per acre
(i) Italian ryegrass or certified New Zealand short-rotation ryegrass	4
Perennial ryegrass, certified S.24	12
Late-flowering red clover	2
Broad red clover	4
White clover (S.100 or certified New Zealand)	1
	23

	lb. per acre
(ii) Italian ryegrass or certified New Zealand short-rotation ryegrass	4
Cocksfoot	12
Late-flowering red clover	3
White clover (S.100 or certified New Zealand)	2
	21

	lb. per acre
(iii) Timothy	6
Meadow fescue	8
White clover (S.100 or certified New Zealand)	2
	16

The above three mixtures are designed for grazing during the first year

4. LONG-DURATION GRAZING LEYS, SIMPLE MIXTURES

Using Bred Strains

	lb. per acre
(i) Perennial ryegrass, certified S.24	8
Perennial ryegrass, certified S.23	4
Perennial ryegrass, certified S.101	4
White Clover, certified S.100	1½
Wild white clover, certified S.184	½
	18

	lb. per acre
(ii) Timothy, certified S.48	10
White clover, certified S.100	1½
Wild white clover, certified S.184	½
	12

	lb. per acre
(iii) Cocksfoot, certified S.26	5
Cocksfoot, certified S.37	5
Cocksfoot, certified S.143	5
White clover, certified S.100	2
	17

5. LONG-DURATION LEYS FOR GENERAL PURPOSES

Three-Year Ley (Cockle Park Type)

	lb. per acre
(i) Perennial ryegrass	14
Timothy	4
Cocksfoot	8
Late-flowering red clover	4
White clover (S.100 or certified New Zealand)	½
Wild white clover	½
	31

This mixture is designed for undersowing and not for direct seeding

Without Ryegrass—Using Bred Strains

	lb. per acre
(ii) Cocksfoot, certified S.37	3
Timothy, certified S.48	4
Meadow fescue, certified S.53 or S.215	6
Late-flowering red clover, certified S.123	2
White clover, certified S.100	1½
Wild white clover, certified S.184	½
	17

	lb. per acre
(iii) Timothy, certified S.48	4
Meadow fescue, certified S.53	8
White clover, certified S.100	1½
Wild white clover, certified S.184	½
	14

	lb. per acre
(iv) Cocksfoot, certified S.143	8
Meadow fescue, certified S.53	8
White clover, certified S.100	1½
Wild white clover, certified S.184	½
	18

6. LUCERNE MIXTURES

	lb. per acre
(i) Lucerne (inoculated)	14
Meadow fescue, certified S.215	3
	17

	lb. per acre
(ii) Lucerne (inoculated)	14
Timothy, certified S.51	3
	17

	lb. per acre
(iii) Lucerne (inoculated)	14
Cocksfoot, certified S.37	3
	17

BOOK REVIEWS

Insect Control by Chemicals. A. W. A. BROWN. Chapman and Hall. £5.

Dr. A. W. A. Brown, Professor of Zoology at the University of Western Ontario, has written a remarkably complete book on insecticides, although, quite understandably, it relies very largely on American work and results, it is a worthy successor of Dr. H. Martin's *Scientific Principles of Plant Protection*. It is indeed refreshing to see a biologist undertaking this work, as in the past this subject has too often been approached by chemists, and excellent as these works have been one could not escape the suspicion that the authors failed to appreciate the inherent variability of insect species. Dr. Brown nowhere regards the killing of an insect as just another chemical reaction, and consequently his book is of immense value to the students, experimentalists and practical men concerned in the destruction of these animals.

In a short review one cannot do justice to this important work and it is possible only to describe some salient features. In the first place, it is acknowledged today that the subject of insecticides is extremely complicated ; this book assembles and clearly sets out the existing authoritative information on the subject. Anyone who reads it will have in his mind a knowledge of what our modern chemicals will do to insects, other animals and plants, and where information is incomplete he will have the partial or conflicting evidence clearly presented. He will also acquire a valuable reference book, much new material and an indication of our future road.

Up to the present our knowledge of insecticides has been almost entirely empirical. Scientists everywhere are trying to overcome this, and Professor Brown, in his second chapter, gives an admirable summary of our knowledge on the relationship between structure and insecticidal action, and shows that we cannot as yet build a molecule and say " This will be an insecticide."

All the old and the new insecticides are described, as is also the physiology of the insect cuticle. Methods of application are not neglected, and there is a full chapter on aerial spraying and dusting. The toxicity of the chemicals to plants and other animals is dealt with extensively.

The only adverse criticism it is possible to make is that the economics of control are scarcely dealt with : there is no mention of the extent of the damage done by insects or of the cost or economic advantages of using the many insecticides described. This is an unfortunate omission, since growers must be satisfied upon the economics of the treatments proposed. The book, however, is very valuable and should be read by all, from scientist to field worker, interested in reducing the ravages of insect attack on crops and animals.

F.G.O.

Elements of Plant Protection. LOUIS L. PYENSON. Chapman and Hall. 40s.

This is an all-American book on the modern trade or business of Plant Protection. It gathers together much that the good salesman or technical representative needs to know about the whole multiple business, which includes spraying crops against insect pests and plant diseases, chemical weed-killing, and poisoning rats, woodchucks, pocket gophers and other vermin. It is designed, when reinforced with a good deal of practical work, to provide a thoroughgoing one-semester American college course in this heterogenous technology. It goes over the principles of control and contains many life-cycle diagrams and illustrations of typical pests and diseases and common weeds. The book will be found useful over here for the information it contains on American practice, and especially for its numerous tables giving rates of application and trade names of some of the newer insecticides, fungicides and weed-killers. Much discrimination is needed, however, in picking out those parts of the information on pests and diseases that are applicable under English conditions, and students should be warned that some of the plant pathological jargon differs from ours.

E.C.L.

Common Farm Weeds Illustrated. Published for Plant Protection Limited by Butterworth. 15s.

It is a truism that the more intensive the method of farming, the greater is the technical knowledge it is necessary for the farmer to possess. No matter what field of farming or market gardening one considers, there is on all sides a demand for the technical information without which it is very difficult to increase and improve production. The modern technique of selective chemical weed control has developed in such a remarkable way in the last ten years that, in 1952, two and a half million acres of our crops were sprayed to control weeds. There is no doubt as to the benefits which can be obtained by removing weed competition in cereals and grassland, but those who have themselves undertaken this spraying are the first to recognize the difficulties. The field technique of how much chemical to use and how to apply it can be learned from the various instruction manuals and leaflets which describe this aspect of spraying. Another problem for the farmer which, if not considered very carefully can lead to a waste of money and effort, is the proper recognition of weeds which it is desired to control. Very few of the books available to the farmer which describe weeds in either simple or botanical language deal adequately with the recognition of seedling weeds—the stage of growth at which it is essential to identify a species before spraying it. *Common Farm Weeds Illustrated*, which has been prepared by Mr. and Mrs. D. L. W. Scovell in collaboration with the Plant Protection Research Station at Fernhurst, sets out to fulfil a demand for a simple means of recognizing the common weeds in the adult, and especially in the seedling, stage : in this it succeeds admirably.

The book, which is attractively produced, runs to 172 pages, contains a good index and gives nearly half of its total space to black and white photographs. The 78 species are described very briefly in both the seedling or non-flowering and adult stages, each being illustrated by a photograph. With few qualifications, it can be said that the seedling photographs in particular are an excellent guide to the identification of these common species. The weeds are grouped according to whether they normally infest arable or grassland, each group being subdivided in respect of flower colour. This is an excellent method of division when the greatest degree of simplicity is the aim, but it must be pointed out that grouping by flower colour will seldom help the farmer wishing to identify a weed in the seedling stage unless he remembers the colour from a previous year.

Careful examination discloses only one very obvious mistake : the Latin name for White Campion is different under each of the two photographs ; the name generally adopted today is *Melandrum album*, the other that which it replaced *Lychnis alba*. It would be helpful if there were a close-up photograph or diagram of the seed capsules or seeds of those species where this detail could assist in identification. It would also be of value if a description of the Winter Wild Oat (*Avena ludoviciana*) could be included in addition to that of the Spring Wild Oat (*Avena fatua*).

This book should help farmers and others who want a really simple guide to assist weed identification, as few other books have done. Nothing so simple can ever be foolproof, but, for the purposes for which it has been prepared and very well illustrated, it deserves and is likely to have, a wide demand. Sir Edward Salisbury has contributed a short foreword.

C. V. D.

BOOK REVIEWS

Reclaiming Land for Agriculture. MOSES GRIFFITH, J. F. H. THOMAS and R. LINE. Crosby Lockwood. 12s. 6d.

I found this book very readable, and of considerable interest. It seemed to be a very useful book which would tell laymen how and why land is reclaimed ; it has considerable propaganda value and would no doubt serve as an introduction to the subject and inspire many farmers to make a closer study of the problems involved and perhaps embark on a reclamation programme of their own.

Of its value as a text-book for people actually engaged in reclamation work, I have considerable doubts ; there are so many instances of lack of care in checking matters of detail. Although most of these points are relatively unimportant and do not detract from the usefulness of the book in giving a broad picture, the statement (on p. 85) that " The Wash covers by tidal waters, within the region mentioned, about 100 sq. miles, which one hopes may some day in the not distant future be the scene of major operations in land reclamation " is likely to suggest erroneously to readers that the whole area is potentially reclaimable. A recent official estimate gave the total area ripe for reclamation in the Wash as between 10 and 15 sq. miles. The greater part of the remainder is pure sand, at present unsuitable for any agricultural purpose, and unlikely to be reclaimed for many centuries.

J.V.S.

Farmer and Stock-Breeder Year Book, 1953. 10s. 6d.

It is with great pleasure that we welcome the 77th Year Book from the Farmer and Stock-Breeder—a useful, handy work of reference, attractive, well dressed, and, what is particularly important these days, reasonably priced. It carries thirteen excellent illustrated articles, all by leading authorities, on such subjects as foot-and-mouth disease, pig production, beef supplies, sheep on the general farm, fertilizers, cereals, mixed corn, and safeguarding soil fertility. Ways of tackling the problems of world food shortage are discussed by Mr. Norris E. Dodd, Director of F.A.O.

The 50 pages of pedigree stock pictures, a feature we have now come to look for, are as well produced as ever. The section devoted to famous show champions of the years between the wars will be of special interest to stockmen, and is almost certain to call forth reminiscences (and argument) wherever they foregather.

The blue-coloured reference section of 143 pages includes some useful tables of weights and measures in addition to the usual items. In short, the Year Book is a mine of information for farmers to dig into.

K.M.C.

Department of Hop Research, Wye College. Annual Report, 1951. 4s.

A number of items of direct interest to growers, advisory workers, and brewers are contained in this account of experimental work on hops.

Field trials on the manuring of hops, in which the rates of fertilizer application recommended by the Department were compared with those commonly used in commercial practice, have confirmed that hop growers tend to use unbalanced and excessive amounts of fertilizer. It seems clear, for example, that under some conditions, hops can grow well at much lower levels of phosphate manuring than are normally maintained by growers. Similarly, the liming experiments described in another section of the report indicate that hops can make good growth under more acid soil conditions than is generally supposed.

A third of the report is devoted to an interesting and detailed description of the second survey of hop-picking machines. This is of particular interest in view of the increasing difficulty in some areas of securing the services of hop pickers. Data is given for the performance of a number of machines operating under commercial conditions over a four-week period. From this, it appears that some of the total soft resin content, on which the preservative value of hops in brewing depends, is lost by all machines of current design. These losses also increase with the greater use of air power in the cleaning part of the machines. As in other branches of mechanical harvesting, the growing of the crop needs to be carried out to suit the machine. Hop plants bearing a greater weight of hops than of leaf and stem yield better machine-harvested samples than those where the leaf and stem outweigh the hops.

An account is given of a new hop variety resistant to Verticillium Wilt, named Brambling Cross, of which a small quantity of rooted sets are now available. Some early-ripening hops, which have been grown at Wye and examined for their commercial value, are described.

The report also includes a note on variability in Canadian wild hops, and details of the results of the Institute of Brewing challenge cup competition, 1951, for new varieties of hops.

A.J.L.L.

BOOK REVIEWS

Oxfordshire (County Books Series). JOANNA CANNAN. Hale. 18s.

Despite the fact that she is writing about one of the smaller English counties, Miss Cannan has had a formidable task in condensing the story of Oxfordshire and its people into 262 pages. Nevertheless, her approach is interesting and shows a keen regard for the country folk, even though in dealing so fully with the more permanent features of the countryside she has to dismiss them without telling us much about their way of life. Oxford City and University have naturally been given a big place in the picture, and in the space available have been treated admirably. But this unfortunately leaves all too little room for treatment of the lesser towns and parishes ; indeed many of the latter are disposed of in a passing note. I was particularly interested to see how she developed the theme of the book along the river valleys.

The author's problem appears to have been to know what to put in this book and what to leave out, but, certainly the result has been to whet the appetite to go and see for oneself. And that, after all, is presumably the aim of the book.

J. S. McF.

Egg Incubation. WILLIAM MARSHALL. Poultry World. 2s. 6d.

The author of this book is well known as the head of the Incubator Research Department of Papworth Industries and as a biologist. He has traced the sequence of events from the formation of the egg to the hatching of the chick, and has placed in their proper perspective the importance of genetics, good feeding of breeding stock, the careful selection of hatching eggs, and the role of the incubator. Mr. Marshall writes in a clear and very readable manner, and places in the hands of everyone who would understand incubation the means to do so. It is particularly important to bear in mind his remark that " success in incubation, as in every other business, depends upon the attention which is paid to details ". All too often failures are due to lack of attention to detail. The section on incubator rooms and their ventilation is excellent.

It is because this book is so readable, and may well become the handbook of the incubator user, that it is necessary to say that some errors have somehow crept in on the way to publication. An errata slip, which should be included, will point these out to the reader. As an example, on page 45 the text implies that vitamin B_{12} and riboflavin are one and the same entity, whereas vitamin B_{12} is a recently discovered part of the animal protein factor, and riboflavin is vitamin B_2, late vitamin G. Both are necessary for good hatchability, but they must not be confused, especially as their sources are different.

W.M.A.

The Nature of Fowl Nephritis (A.R.C. Report Series 11). W. G. SPECTOR. H.M. Stationery Office. 3s. 6d.

This report describes an investigation into nephritis (inflammation of the kidneys), and associated conditions of visceral gout and pullet disease, which, the author concludes, represent a pathological entity—pyelonephritis of a progressive, chronic nature bearing an intimate relationship to stagnation of the urine. The possible association with uric acid metabolism and with a condition known as " Messy Vent " is discussed. No support for a hereditary basis for the disease is produced. The microscopic nature of the disease is discussed in detail, and the text is very fully illustrated by 38 microphotographs.

The report is intended chiefly for veterinarians and others working on problems of physiology and pathology of the fowl ; its technical nature renders it of little interest to the practical poultry farmer.

J.C.

The Polished Ploughshare. SYD FOX. Watts. 1s.

Mr. Fox, in this short but admirable monograph, has successfully, and in a readable form, achieved his purpose of " providing a starting point for those who may wish to study . . . the topics here outlined". He has shown how science can help the farmer, and the way scientific development crosses and modifies the path of traditional agriculture. The relationship that should exist between the laboratory and the farm is clearly indicated ; and this, in particular, will be welcomed by those of us whose business it is to prove that science married to practice can give the country more food, and farmers and workers a fuller life. It is sometimes maintained that there is a conflict between Authority, in this case science, and Experience. Perhaps Mr. Fox will have more space in his next book to deal with this aspect of a fascinating subject. Meantime, this little book gives a clearer insight into the impact of science in agricultural practice than many more ambitious efforts. It is a pity, however, that the binding of this book has not the more lasting qualities of the polished ploughshare !

A. J.

BOOKS RECEIVED

Agricultural Market Prices (2nd Edition). W. C. WAITE and H. C. TRELOGAN. Chapman and Hall. 42s.

Alkali Soils. W. P. KELLEY. Reinhold Publishing Corporation. 40s.

The Canadian GrainTrade 1931–1951. D. A. MACGIBBON. Toronto University Press. 36s.

Cerne Abbas. MARY D. JONES. Allen and Unwin. 10s. 6d.

The Conservation of Ground Water. HAROLD E. THOMAS. McGraw-Hill. 42s. 6d.

Food Hygiene. W. CLUNIE HARVEY and HARRY HILL. H. K. Lewis. 35s.

The Genetics of Garden Plants (4th Edition). M. B. CRANE and W. J. C. LAWRENCE. Macmillan. 20s.

The Injurious Insects of the British Commonwealth. J. W. EVANS. Commonwealth Institute of Entomology. 30s.

Interregional Competition in Agriculture. R. L. MIGHELL and J. D. BLACK. Harvard University Press. 32s. 6d.

Introductory Animal Science. W. P. GARRIGUS. Lippincott. 45s.

Iodine Content of Foods (Annotated Bibliography 1825–1951). Chilean Iodine Educational Bureau. 21s.

Irrigation Engineering. Vol. 1. Agricultural and Hydrological Phases. F. E. HOUK. Chapman and Hall. 72s.

Observer's Handbook. Meteorological Office. H. M. Stationery Office. 12s. 6d.

Pathology in Forest Practice (2nd Edition). D. V. BAXTER. Chapman and Hall. 60s.

Vertebrate Sexual Cycles. W. S. BULLOUGH. Methuen. 6s.

Water. SIR CYRIL S. FOX. The Technical Press. 30s.

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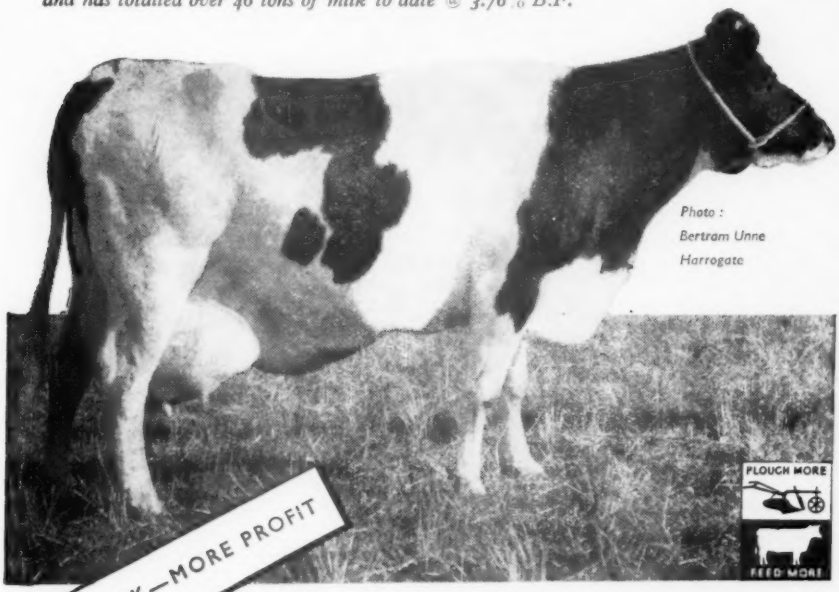

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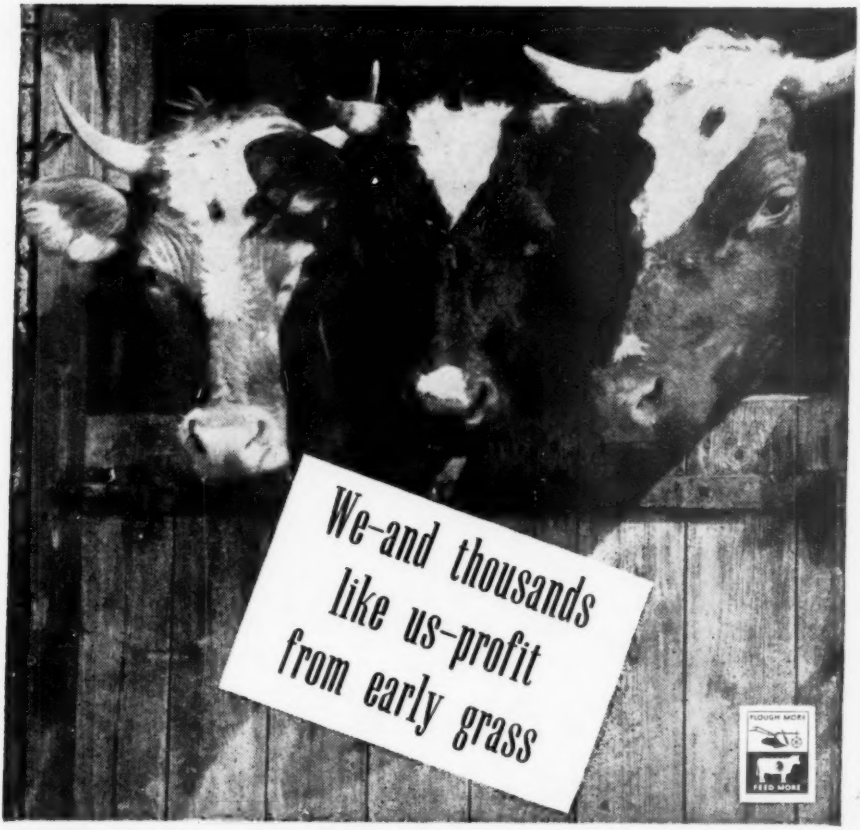

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